DELHI: ONE CITY MULTIPLE DESTINIES
Impact of the metro rail on urban form

by
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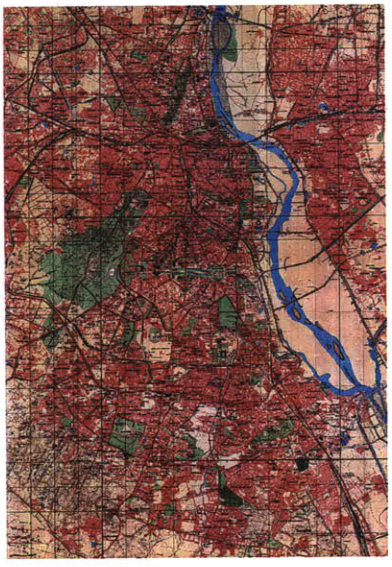

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ABSTRACT

Cities grow and with it urban form, unique to each, keeps evolving. Delhi can be perceived as having a polycentric, poly-nodal, radial city structure and a circumferential and partly sectoral form. World over, cities have evolved from a complex relationship between numerous influencing factors. It can be argued that in present times, transport and technology are the two significant pre-cursors of change. The next decade in India is going to see massive interventions in urban areas with regard to infrastructure, especially those related to transportation. The city of Delhi is an appropriate case to examine in this regard as currently a mass rapid transport system is being introduced in the city.

Delhi is a unique city as it is probably the only capital city in the world both in terms of its physical size and population it serves that relies only on busses for public transport. It is also a city which has grown rapidly post independence failing any formal planning interventions proposed by the subsequent master plans for its containment. The introduction of the new transit system being one of the biggest financial investments in the city post independence is seen as an opportunity to restructure the city to accommodate an increase in population of 10 million people and also to define future urbanization trends in the region.

This thesis is an inquiry aimed at understanding as to how the advent of mass transit can be utilized by a city like Delhi to limit its sprawl and address changes in land use patterns. A study of other world city regions encourages one to think that intensifying development along transit corridors and at nodes is one option which could lead to a more efficient distribution of people in the city of Delhi. The thesis also questions the nature of present planning framework for the city and suggests appropriate planning and policy adjustments to complement the pattern of development proposed in context with the opportunities presented by the advent of the new mass transit system.

Thesis Supervisor: John de Monchaux
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“To create a new city is easy, an act of optimism, to renew and sustain an existing one is an act of courage” – Rahul Mehrotra in “Bombay to Mumbai: Changing Perspectives.”

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01 INTRODUCTION

1.1 SPRAWL, URBAN FORM AND THE METRO RAIL

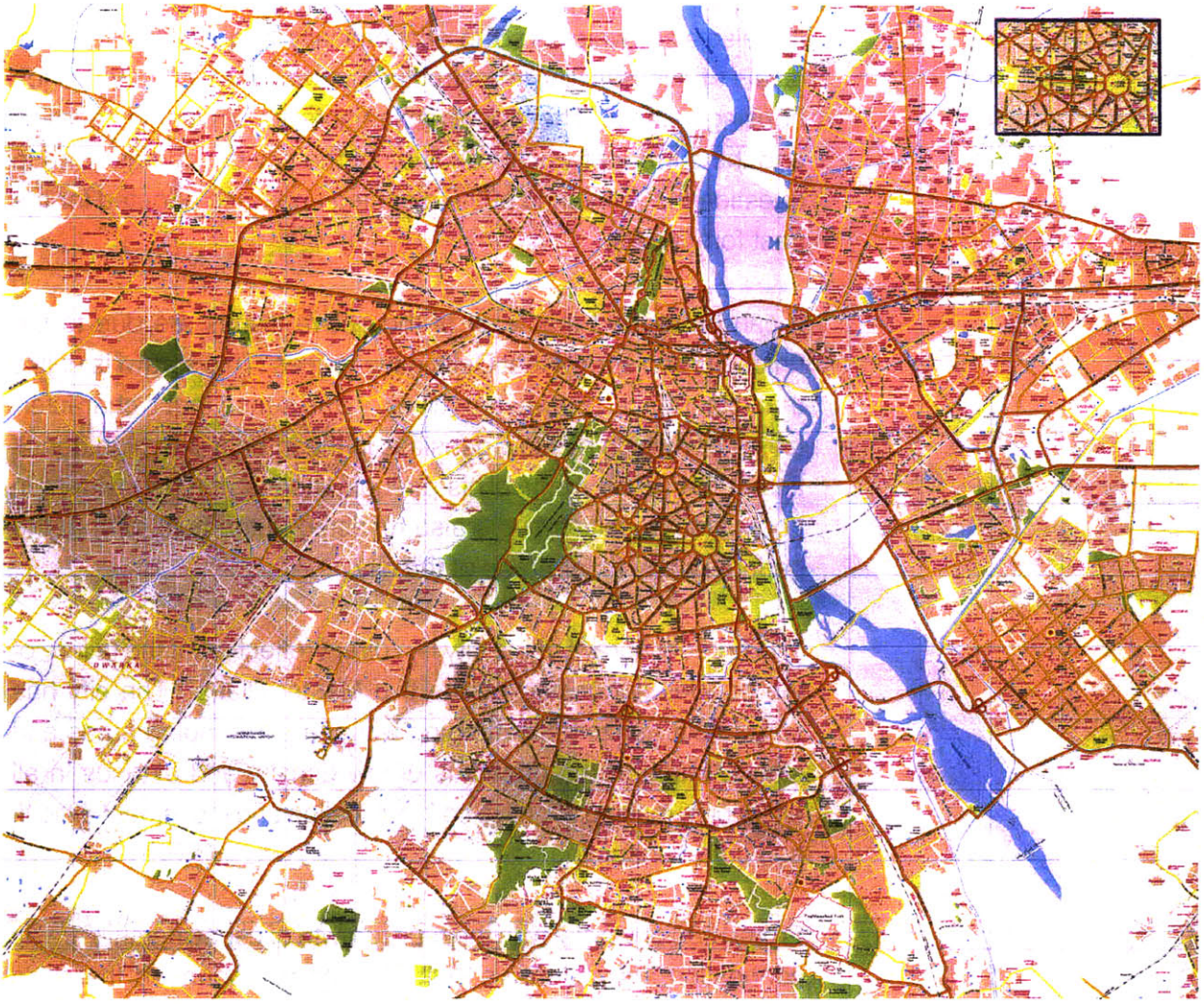
Cities from time immemorial have been products of the numerous forces that shape and change them. Traditionally one has identified these to be related to history, transport and market forces. In the absence of investment in infrastructure, most cities in India have been shaped by the influence of history and market forces alone.[1] It can be argued that in the near future, massive interventions of transport infrastructure in urban areas in India would present opportunities for restructuring existing cities.

Delhi is one such case which is currently having a new rail based mass transit system being introduced in the city. The first phase of the mass transit system is currently operational in parts and the system is expected to be completed in its totality by the year 2021. Also, presently the Delhi Development Authority (DDA), which is the primary development agency in the city, is preparing the next Master Plan for the year 2021. As a result Delhi is at an interesting point in time where it is not only receiving large investment in the form of transport infrastructure but is also planning its future for the next twenty years. Thus there is an opportunity for it to create a new destiny for itself, one which would lead to a more livable city and help address some of the physical and social issues that currently challenge it.

The map on the opposite page is representative not only of Delhi's sprawl across both sides of the river Yamuna but also represents a city of approximately 14 million people.[2] It is a city which like many other Asian cities has experienced rapid urban growth and population explosion in its post independence era due to distress migration from rural to urban areas. It also shows a city which will expand to at least 24.5 million people by the year 2021.[3]

The key issue that the city needs to address is that how will it cater for the additional number of people in the future? Will it increase the urbanized area by transferring development to satellite cities in neighboring states or will it urbanize the existing agricultural and rural land thus leading to a possible ecological imbalance?[4]

Some of the above mentioned approaches have been adopted in the past without much success. In this scenario it would be



[Fig. 1.1] Map showing the present Delhi Urban Area
Source: Eicher City Map

worthwhile for the city to look at the opportunities presented to it by the advent of the new transit system and examine if these could be used to restructure the city so as to increase the supply of urban land and its total holding capacity in the presently urbanized area itself.

Lack of accessibility, increasing urban densities, rapid rates of urbanization and high population growth rate due to migration are challenges that are experienced by many other developing world cities but what makes Delhi's case as the capital city of the world's largest democracy unique is the fact that even though it has always been a planned city (from the colonial era till date), it appears at present to be a city of fractured identities, disconnected localities, alienated residents, confused plans and policies – a city of multiple parts with no cohesive vision for its future.

It is also a city which is socio-economically inequitable in terms of levels of accessibility, infrastructure provision and an overall job housing balance. The lack of implementation of planning policies and the current physical condition of the city encourages one to question the relevance of the planning approach adopted for the past forty years.

It can be argued that a lot of the above issues are due to the unique urban sprawl that Delhi experiences. This sprawl is unlike that experienced by western cities, in the sense that it characterizes a city which has low densities in the interior and high densities at the urban fringe. This phenomenon is not just evident in population densities but is also reflected in the built form at the periphery and inner areas of the city.

The present sprawl of the city is a direct reflection of the failure of the policies suggested by the two Master Plans.[5] The city has spread out horizontally merging with the surrounding areas and states. Much of the growth is of low density and extends in all directions, making effective communication and movement difficult and time-consuming.

From 1980 onwards, with the rapid growth of car ownership[6] traffic congestion and extensive pollution has compounded the city's problems. Introduction of mass transit supported with good planning and policy at the micro scale can potentially form an over all framework in which development is bottom up and yet is guided by a strategic plan at city level.

Delhi forms an interesting case to study as there are very few cities in the world of its size which have introduced such big investment in the form of transit at such a late stage. In the absence of truly comparable precedents one can speculate that the mass transit system for a city like Delhi can even enhance the sprawl further. The challenge then is to devise urban strategies using transit to restructure the city so that it can limit the sprawl if not reverse it. Successful case examples of micro scale development as seen in Singapore and Curitiba encourage one to think that the advent of the metro rail would present Delhi with an opportunity for better urban development and this in turn would

help address issues related to all segments of society leading to better conditions for 'livability' in the city.

[Fig. 1.2] Map showing the new mass transit system for Delhi
Source: Delhi Metro Rail Corporation

The thesis aims to explore redensification possibilities for four areas in the city of Delhi which would be served by the new mass transit system and extrapolates these findings to the city as a whole to form an overall scenario for 2021. It also questions the current planning practice and proposes suitable adjustments in policy to take advantage of the micro scale design proposals.

1.2 HYPOTHESES

The advent of mass transit presents an opportunity for Delhi to restructure itself by intensifying development at nodes along the rail corridors; this phenomenon when imposed on a sprawl city model such as Delhi would:

a) Increase the supply of urban land thus accommodating future population in the presently urbanized area and,
b) Transform the overall form of the city from a sprawl model to a city of distributed urban growth.

1.3 APPROACH TO THE STUDY

The approach for the study has been to understand the relationship between transit, urban form and land use both theoretically and through case examples. These are reviewed in chapter two of this thesis.

Following this theoretical review, in chapter three an attempt has been made to understand the evolving form of Delhi with respect to densities of built form and population, physical infrastructure issues of transportation and accessibility in the city. The chapter also explores the policies of the development agency that have shaped the present model of the city.

Chapter four describes the future visions for Delhi in context with the introduction of the new mass transit system. Following this a case has been made in favor of a new approach for guiding city design based on micro scale urban interventions guiding the development pattern of the city structure rather than the usual master plan approach as followed in Delhi.

Chapter five explores the above mentioned micro scale urban intervention approach by demonstrating it in four areas in the city. These have been considered as prototype nodes for development and an examination of each of them reveals that it is possible to accommodate more number of people in the same area along with a variety of land uses.

Chapter six forms a framework to help guide the future macro form and growth of the city in context with the findings of the previous chapter. It also talks about policies and institutional

adjustments that need to complement such interventions and concludes with an emerging scenario for Delhi in the year 2021.

The thesis investigation is based primarily on secondary sources of information with some primary surveys done in the area of Silampur and Rohini. The thesis is also limited from the data of the 1991 census and the fact that currently there is no structure plan or outline development plan available for the Delhi Urban Area.

Lastly the findings from the four cases have been used to extrapolate a scenario for the city as a whole. Since opportunities for development may not be uniform in all areas a detail study would be required in the future for each of the nodes to formulate a comprehensive plan for the city as a whole.

Notes

[1] Delhi, till the year 2002 had only busses as means of public transportation.

[2] National Capital Region Planning Board Report 1991.

[3] DDA population projections for 2021 Master Plan.

[4] In 2001, 64,000 Ha of the total 144,700 Ha land area in Delhi was urbanized. This implies that approximately 45% of the total land area was used for urban development. At the same rate, by 2021, Delhi will need to utilize 120,000 Ha of its 144,700 Ha area for the 24.5 million population and that would amount to almost 85% of the total land resource.

[5] First Master Plan was prepared for the period of 1961-1981 and the second one was for 1981-2001.

[6] There are more cars in Delhi than the metropolitan cities of Bombay, Calcutta, and Madras put together.

02 CITY REGIONS: THEORIES AND CASE STUDIES

Most city regions around the world have experienced dramatic changes during the twentieth century. They have grown in size, population, character and spatial form. This chapter attempts to understand the relationship between transportation and its implications on urban form and land use. It also talks about models of urban transit and problems associated with transportation in developing countries. The chapter concludes by examining issues related to urban sprawl and transit oriented development in cities of developing countries.

2.1 THEORIES

Urbanization has been one of the dominant contemporary paradigms as a growing share of the global population lives in cities. Considering this trend, urban transportation issues are of foremost importance to support the passengers and freight mobility requirements of large urban agglomerations. Transportation in urban areas is highly complex because of the modes involved, the multitude of origins and destinations, and the amount and variety of traffic. Traditionally, the focus of urban transportation has been on passengers as cities were viewed as locations of utmost human interactions with intricate traffic patterns linked to commuting, commercial transactions and leisure/cultural activities.

However, cities are also locations of production, consumption and distribution, activities linked to movements of freight. Conceptually, the urban transport system is intricately linked with urban form and spatial structure. Urban transit is an important dimension of urban transportation, notably in high density areas, as viable cities are linked with efficient transit systems. To understand the complex relationships between transportation and land use and to help the urban planning process, several models have been developed.

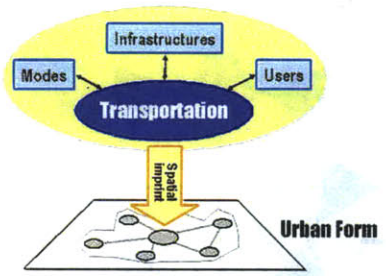
2.1.1 TRANSPORTATION AND URBAN FORM

■ Elements of the Urban Form

Urbanization has been one of a dominant trend of economic and social change since the second half of the 20th century, especially in the developing world. Urban mobility issues, notably the requirements to satisfy it, have increased proportionally with urbanization, a trend reflected in the growing size of cities and in the increasing proportion of the urbanized population. Since 1950,

the world's urban population has more than doubled, to reach nearly 3 billion in 2000[1], about 47% of the global population.

This is in part due to demographic growth and rural to urban migration, but more importantly to a fundamental change in the socio-economic environment of human activities. Current trends indicate a growth of about 50 million[2] urbanites each year, roughly a million a week. More than 90% of that growth occurs in developing countries. By 2050, 6.2 billion people[3], about two thirds of humanity, will be urban residents.



[Fig. 2.1] Transportation and Urban Form
Source: Adapted from Hartshorn, "Interpreting the city".

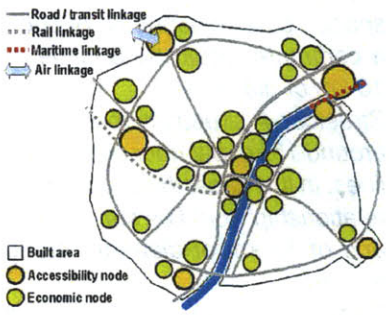
At the urban level, demographic growth and mobility have been shaped by the capacity and requirements of urban transport infrastructures; be it roads, transit systems or walkways. Consequently, there is a wide variety of urban forms and urban transportation systems as urban form is the spatial imprint of an urban transport system. Even if the geographical setting of cities varies considerably, these relationships are articulated by two structural elements whose function remains constant:

- **Nodes**
  They express the centrality of urban activities. This can be related to the spatial accumulation of economic activities.

  Terminals, such as ports, rail yards and stations, and airports, are important nodes around which activities agglomerate at the local or regional level. Nodes have a hierarchy related to their importance and contribution to urban functions, such as production, management and distribution.

- **Linkages**
  They refer to the infrastructures supporting flows from, to and between nodes. The lowest level of linkages includes streets, which are the defining elements of the urban spatial structure.

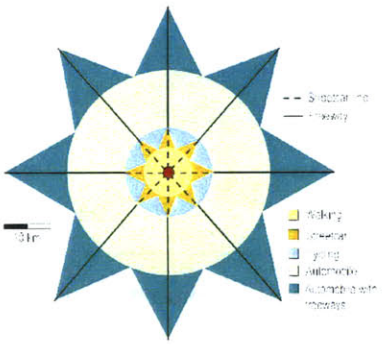
  The hierarchy of linkages climbs up to regional roads and railways and international connections by air and maritime transport systems.



[Fig. 2.2] Nodes, Linkages and Urban Form
Source: Adapted from Hartshorn, "Interpreting the city".

There are two basic forms of interdependent nodes:
Accessibility nodes. Refer to locations that transfer passengers and freight. Includes ports, rail stations, and airports.
Economic nodes. Refer to locations that perform a function of economic significance.
The presence of nodes requires linkages, which can be serviced by different transport modes.

Urban transportation is organized according to collective, individual and freight transportation. In several instances, these modes are



[Fig. 2.3] One Hour Commuting According to Different Urban Transportation Modes
Source: Adapted from Hugill

For a commuter, the relationship between space and travel time changes dramatically with the transportation mode used.

Walking. Assuming a willingness to commute for one hour, a pedestrian walking at 5 km per hour could cross about 5 km. The space / time relationship of such a commute would be a circle of 10 km of diameter.
Streetcar. A streetcar, could travel around 15 km per hour along fixed lines. In this case, the space / time relationship would be star shaped and of 15 km of diameter along the lines.
Cycling. The same speed of a streetcar, but with no fixed line limitations, the space / time relationship of commuting by bicycle would be a circle of 15 km of diameter.
Driving (no freeways). With a driving speed of about 30 km per hour (taking into account of stops, lights and parking), an automobile creates a spherical space / time relationship of about 30 km in diameter.
Driving (with freeways). Along a freeway, a fixed infrastructure, the driving speed is doubled to 60 km per hour. The space / time relationship is star shaped with 60 km of diameter along its axis.

complementary, but sometimes they may be competing for the usage of available land and/or transport infrastructures.

- **Collective Transportation (public transit)**
  The purpose of collective transportation is to provide publicly accessible mobility over specific parts of a city. Its efficiency is based upon transiting a vast number of people while benefiting from economies of scale. It includes modes such as tramways, buses, trains, metro and ferryboats.

- **Individual Transportation**
  Includes the car, walking, cycling and the motorcycle. The majority of people walk to satisfy their basic mobility, but this number varies according to the city considered. 88% of movements inside Tokyo are done by walking while this figure is only 3% for Los Angeles.

- **Freight Transportation**
  As cities are dominant production and consumption centers, these activities are accompanied by large movements of freight. These movements are mostly characterized by delivery trucks converging to industries, warehouses and retail activities as well as to major terminals such as ports, rail yards, distribution centers and airports.

Conventionally, movements within cities tend to be restricted to walking, making medium and long distance urban linkages rather inefficient and time-consuming. As such, activity nodes tend to be agglomerated and urban forms compact. Many modern cities have inherited an urban form created under such circumstances, which are no longer prevailing. The dense urban cores of many European, Japanese and Chinese cities, for example, enable residents to make 30 to 60% of all trips by walking and cycling. On the opposite, the dispersed urban forms of Australian and American cities, which were built recently, encourages automobile dependency.

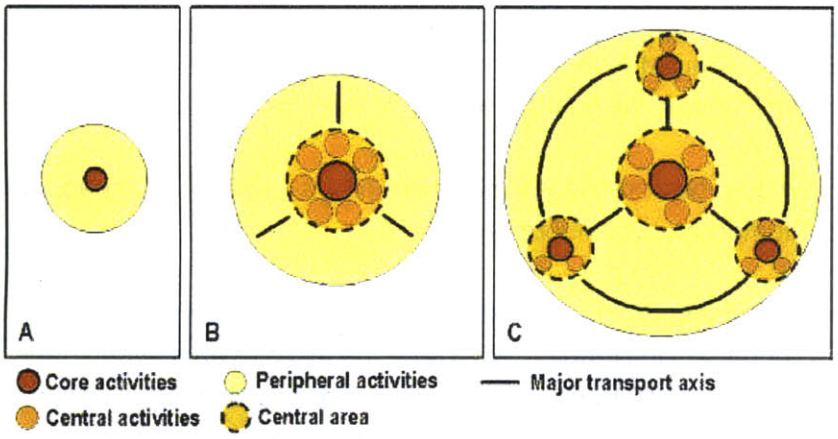
Urban transportation is thus associated with a spatial form which varies according to the modes being used. In an age of motorization, an increasing number of cities are developing a spatial structure that increases reliance on mechanized

transportation, namely the privately owned automobile. Dispersion or urban sprawl is taking place in many different types of cities, from dense, centralized European metropolises such as Madrid, Paris, and London, to rapidly industrializing metropolises such as Seoul, Shanghai, and Buenos Aires, to those experiencing recent, fast and uncontrolled urban growth, such as Bombay and Lagos.

■ Evolution of Transportation and Urban Form

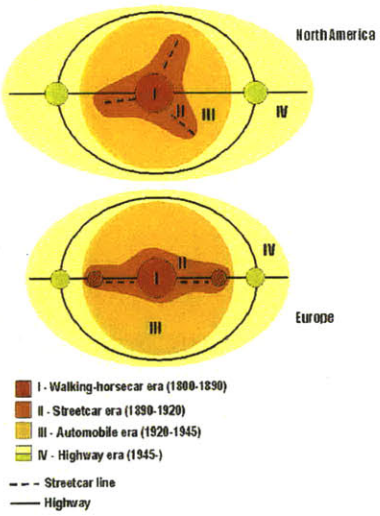
The evolution of transportation has generally led to a change in most urban forms. The more radical the change, the more the urban form was altered. Among the most fundamental changes, is the emergence of new central areas expressing new urban activities and new relationships between elements of the urban system. In many cities, the central business district (CBD), once the primary destination of commuters and serviced by public transportation, is being challenged by changing manufacturing, retailing and management practices. Whereas traditional manufacturing depended on centralized workplaces and transportation schemes, advanced technology has rendered modern industry more flexible.

The growth of suburbs after the Second World War was initially



[Fig. 2.4] Evolution of the Spatial Structure of a City
Source: Adapted from Hartshorn, "Interpreting the city".

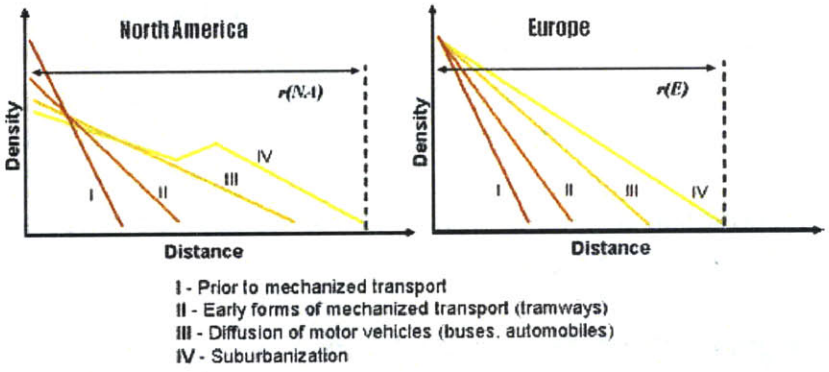
The urban spatial structure considers the location of different activities and their relationships. Core activities are those of the highest order and include tertiary and quaternary activities - involved in the management and consumption of production. Central activities are concerned by production and distribution. Peripheral activities are residential or servicing local needs. Central area refers to an agglomeration of core and, or central activities within a specific location.



[Fig. 2.5] Evolution of Transportation and Urban Form in North America and Europe
Source: Adapted from Muller, P.O. (1995) "Transportation and Urban Form: Stages in the Spatial Evolution of the American Metropolis".

Both North American and European cities have been modified by similar technological changes. However, a different evolution of urban form has occurred between European cities and their American counterparts, especially from the second half of the 20th century. While European cities leaned on public transit, North American cities relied more on the automobile.

restricted to the periphery of roads followed by the gradual filling of spaces between these roads and the cities. Highways and ring roads, which circled the cities, have favored the development of suburbs and the apparition of important cities which compete with the central business district for the localization of jobs, commerce, financial and professional services. As a result, job opportunities have shifted to the suburbs (if not to new locations abroad) and the activity system of cities has been considerably modified. These changes have occurred differently according to the variety of geographical and historical contexts, notably in North America and Europe[4]. In addition, these cities have seen different changes in urban density.



[Fig. 2.6] Evolution of Urban Densities in North America and Europe
Source: Adapted from Muller, P.O. (1995) "Transportation and Urban Form: Stages in the Spatial Evolution of the American Metropolis".

However, two processes that have had a substantial impact on contemporary urban form are:

- **Dispersed urban land development patterns** have been dominant in North America over the last 50 years, where land is abundant, transportation costs are low, and the economy has become dominated by service and technology industries. Under such circumstances, it is not surprising to find that there is a strong relationship between urban density and car use. Many cities have also experienced a faster growth rate of their built areas than their population growth. For instance, between 1950 and 1990 while the population of Chicago grew by 38%, its built area grew by 124%[5]. In addition, commuting has become relatively inexpensive compared with land costs, so households have an incentive to buy lower-priced housing

at the urban periphery. Similar patterns can be found in many European cities.

- **Decentralization of activities** resulted in two opposite effects. First, commuter journeys, many of which now occur from suburb to suburb, have remained relatively similar in duration. Globally, people are spending about 1.2 hours per day commuting, wherever this takes place in a low or high mobility setting. However, commuting increasingly tends to be longer and made by privately owned cars rather than by public transportation, a trend occurring in developing as well as in developed countries. Most transit and road systems were developed to facilitate suburb-to-city, rather than suburb-to-suburb, commuting. As a result, suburban highways are often as congested as urban highways.

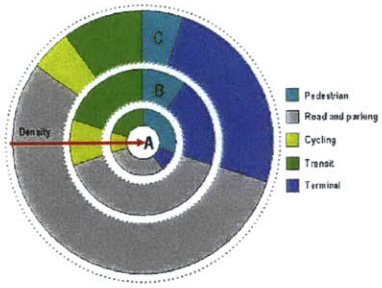
Although transportation systems and travel patterns have changed considerably over time, one enduring feature remains that most people travel less than 30 minutes in order to get to work. Different transport technologies, however, are associated with different travel speeds and capacity. As a result, cities that rely primarily on non-motorized transport tend to be different than auto-dependent cities. In other words, transport technology plays a very important role in defining urban form, i.e., the spatial extent of the built-up area and the spatial pattern of various activities.

■ The Spatial Imprint of Urban Transportation

In the pre-automobile era, about 10% of the land[6] of a city was devoted to transportation, but this figure has changed tremendously. As the mobility of people and freight increased, a growing share of urban areas is allocated to circulation. Large variations of the spatial imprint of urban transportation are observed between different cities as well as between different parts of a city, such as between central and peripheral areas. The major components of the spatial imprint of urban transportation are:

- **Pedestrian Areas**

  Refer to the amount of space devoted to walking. This space is often shared with roads as sidewalks may use between 10% and 20% of a road's right of way. In central areas,



[Fig. 2.7] Rings of Mobility
Source: Adapted from Hartshorn, "Interpreting the city".

The preponderance of each mode in the spatial imprint of urban transportation as a support to urban mobility is dominantly related to density. The above figure shows three rings of increased density, each characterized by specific mobility considerations:
·A (Core area). Often related to a CBD representing the optimum level of urban density and centrality.
·B (Central area). Represents areas of medium to high densities, often adjacent to core areas.
·C (Peripheral / suburban area). Mobility is dominantly provided by road transportation with walking and cycling servicing residual functions, often leisure-oriented.

pedestrian areas tend to use a greater share of the right of way and in some instances; whole areas are reserved only for pedestrians. However, in a motorized context, most of pedestrian areas are for servicing people's access to parked automobiles.

- **Roads and Parking Areas**
  Refer to the amount of space devoted to road transportation, which has two states of activity; moving or parked. In a motorized city, on average 30% of the urban surface is devoted to roads while another 20% is required for off-street parking. This implies for each car about 2 off-street and 2 on-street parking spaces. In North American cities, roads and parking lots account between 30 to 60% of the total urban surface.

- **Cycling Areas**
  In a disorganized form, cycling simply shares access to road space. However, many attempts have been made to create a space specific to the circulation of bicycles in urban areas, namely with reserved lanes and parking facilities.

- **Transit Systems**
  Many transit systems, such as buses and tramways, are sharing road areas, which often impairs their efficiency. Others, such as subways and rail have their own infrastructures and, consequently, their own areas. Many attempts to mitigate congestion have resulted in the creation of road lanes reserved to buses.

- **Transport Terminals**
  Refer to the amount of space devoted to terminal facilities such as ports, airports, rail yards and distribution centers. Globalization has increased the amount of people and freight circulation and consequently the amount of urban space required to support those activities. Many major terminals are located in the peripheral areas of cities, which are the only locations where sufficient amounts of land are available.

The importance of all these spaces varies according to a number of factors, density being the most important. If density is considered as a gradient, rings of mobility represent variations in

the spatial importance of each mode at providing urban mobility. Further, each transport mode has unique performance and space consumption characteristics. The most relevant example is the private car. It requires space to move around (roads) but it also spends 98% of its existence stationary in a parking space. Consequently, a significant amount of urban space must be allocated to accommodate the private car, especially when it does not move and is thus economically and socially useless.

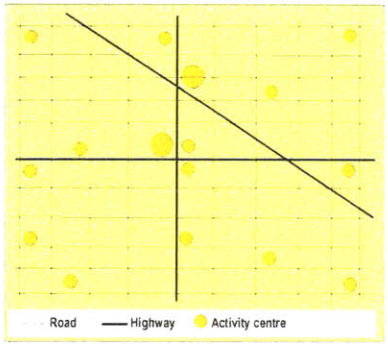
At an aggregate level, measures reveal a significant spatial imprint of road transportation among developed countries. The case of the United States is eloquent. About 155,000 square kilometers are reserved for car use, which equals to 10% of all the available arable land. More land is thus used by cars than for housing[7]. In Western Europe, roads account for between 15% and 20% of the urban surface while for developing countries, this figure is about 10% (6% on average for Chinese cities)[8].

■ Transportation and Urban Structure

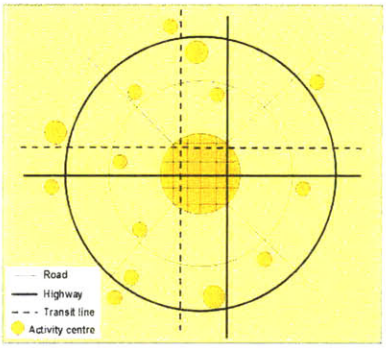
Rapid and expanded urbanization occurring around the world involve a greater number of people living in cities and increased numbers of trips in urban areas. Cities have traditionally responded to growth in travel demand by expanding the transportation supply, by building new highways and/or transit lines.

In the developed world, that has meant building more roads to accommodate an ever-growing number of vehicles, therefore creating new urban structures. Several urban spatial structures have emerged, with the reliance on the car being the most important discriminatory factor. Four major types can be identified at the metropolitan scale[9]:

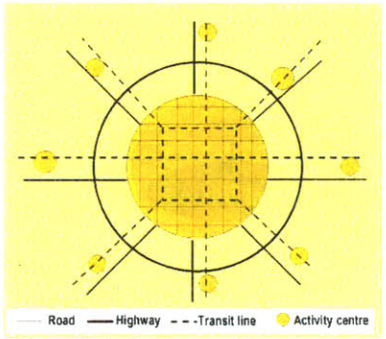
Type I - Completely Motorized Network: Representing a car-dependent city with a limited centrality.
Type II - Weak Center: Representing the spatial structure of many American cities where many activities are located in the periphery.
Type III - Strong Center: Representing high density urban centers with well developed public transit systems, particularly in Europe and Asia.
Type IV - Traffic Limitation: Representing urban areas that have efficiently implemented traffic control and modal preference in



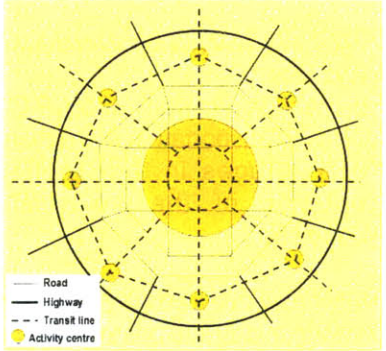
[Fig. 2.8] Type I - Completely Motorized Network; Source: Hartshorn



[Fig. 2.9] Type II - Weak Center; Source: Hartshorn



[Fig. 2.10] Type III - Strong Center; Source: Hartshorn

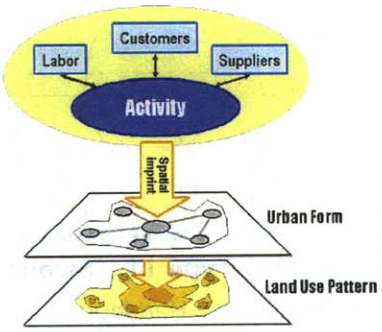


[Fig. 2.11] Type IV - Traffic Limitation; Source: Hartshorn

their spatial structure. Commonly the central area is dominated by public transit.

In addition to available and cheap road transport, several other factors are related to the emergence of suburbia, including, low land costs, available land (large houses), the environment (clean and quiet), safety, and car-oriented services (shopping malls). In those areas, the spatial imprint of the car is dominant with a wide array of roads and parking lots. Initially an American invention, suburban developments have occurred in many cities worldwide, although not many have achieved such low densities and car dependency as in the United States.

Facing the expansion of urban areas and the increasing importance of inter-urban movements, several ring roads were built around major cities. They became an important attribute of the spatial structures of cities, notably in North America. Highway interchanges in suburban areas are notable examples. The extension (and the over-extension) of urban areas have created what may be called peri-urban areas. They are located well outside the urban core and the suburbs, but are within reasonable commuting distances.



[Fig. 2.12] Activity Systems and Land Use
Source: Adapted from Muller, P.O. (1995) "Transportation and Urban Form: Stages in the Spatial Evolution of the American Metropolis".

Activities have a spatial imprint creating a land use pattern, which is influenced by the existing urban form. strongly related to the types of activities.

2.1.2 URBAN LANDUSE AND TRANSPORTATION

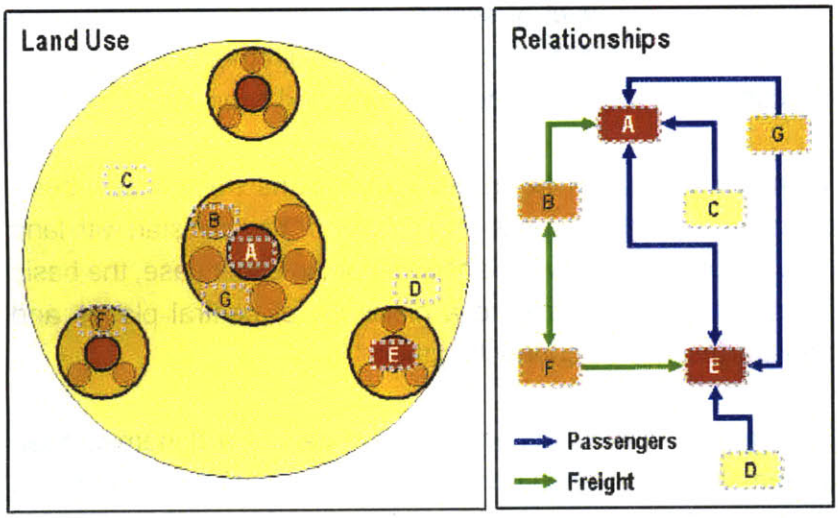
■ The Land Use - Transport System

While urban form is mostly concerned with the patterns of nodes and linkages forming the spatial structure of a city, urban land use involves the nature and level of spatial accumulation of activities. Most human activities, economic, social or cultural imply a multitude of functions, such as production, consumption and distribution. These functions are occurring within an activity system where their locations and spatial accumulation form land uses.

Therefore, the behavioral patterns of individuals, institutions and firms will have an imprint on land use. The representation of this imprint requires a typology of land use, which can be formal or functional:

- **Formal land use** representations are concerned by qualitative attributes of space such as its form, pattern and aspect and are descriptive in nature.

- **Functional land use** representations are concerned by the level of spatial accumulation of economic activities such as production, consumption, residence, and transport, and are mainly a socioeconomic description of space.



[Fig. 2.13] Relationships between Land Uses
Source: Adapted from Muller, P.O. (1995) "Transportation and Urban Form: Stages in the Spatial Evolution of the American Metropolis".

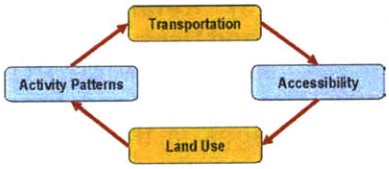
Since urban areas involve specialized land uses having specific functions, each land use zone involves a set of relationships with other land uses. These relationships are expressed by flows of passengers and freight. In the above figure which represents a multicentric city, zones A and E are both commercial with their associated movements of passengers (workers and customers) and freight (suppliers). Zones B and F are distribution centers servicing commercial activities, which implies movements of freight. Zones C, G and D are residential areas (G being of high density) from where flows of passengers are originating.

Land use, both in formal and functional representations, implies a set of relationships with other land uses. For instance, commercial land use has relationships with its supplier and customers. While relationships with suppliers will dominantly be related with movements of freight, relationships with customers would also include movements of passengers. Since each type of land use has its own specific mobility requirements, transportation is a factor of activity location, which in turn is associated with specific land uses.

A key for understanding urban entities thus lies in the analysis of patterns and processes of the transport / land use system. This system is highly complex and includes several relationships between the transport system, spatial interactions and land use:

- **Transport System**
  Considers the set of transport infrastructures that are supporting urban movements of passengers and freight. It generally expresses the level of accessibility.

- **Spatial Interactions**
  Consider the nature, extent, origins and destinations of urban movements of passengers and freight. They take into



[Fig. 2.14] Transportation-Land Use Interactions
Source: Adapted from. Giuliano, G. (1995) "Land Use Impacts of Transportation Investments: Highway and Transit", in S. Hanson (ed) The Geography of Urban Transportation, New York: The Guilford Press, p. 307.

Changes in transportation technology, investment and service characteristics can alter overall accessibility levels as well as the relative accessibility of different locations. Land use changes also affect activity patterns.

consideration the attributes of the transport system as well as the land use factors that are generating and attracting movements.

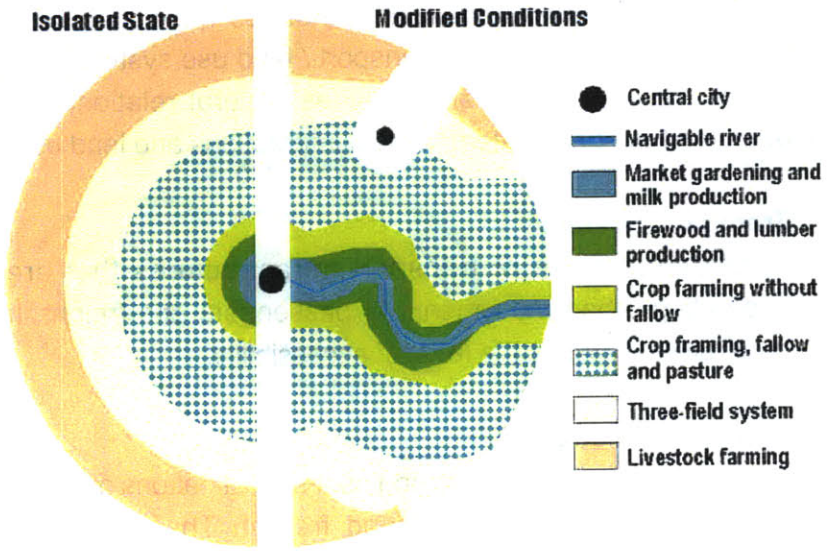
- **Land Use**
  Consider the level of spatial accumulation of activities and their associated levels of mobility requirements. Land use is commonly linked with demographic and economic attributes.

Transportation and land use interactions have often been described as a chicken-and-egg problem: "You can start with land use, or you can start with transportation; in either case, the basic feedback lead inevitably to a hierarchy of central places and transportation links connecting them"[10].

Both land use and transportation are part of a dynamic, open system. However, each is in a constant state of evolution due to changes in technology, policy, economics, demographics and even culture/values. As a result, the interactions between land use and transportation continue to play out in the many decisions made by residents, businesses and governments.

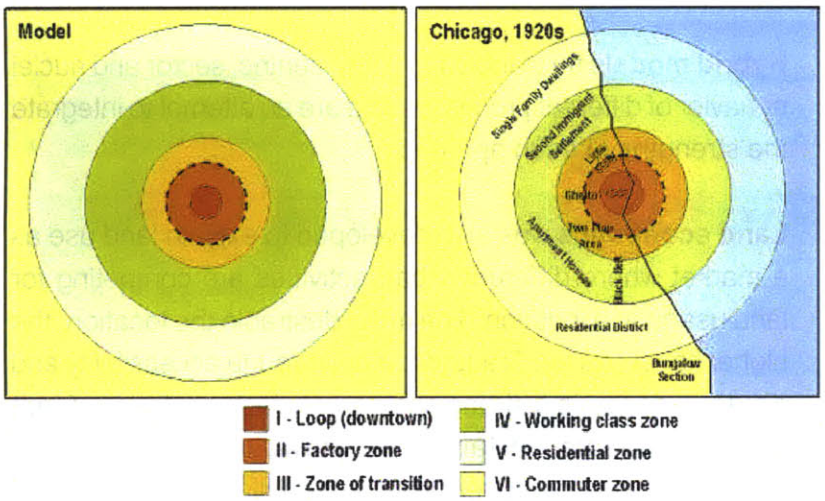
■ Urban Land Use Models

The relationships between transportation and land use have been investigated for a long time. Many descriptive and analytical models have been developed, each providing a dimension of investigation and explanatory elements[11]:



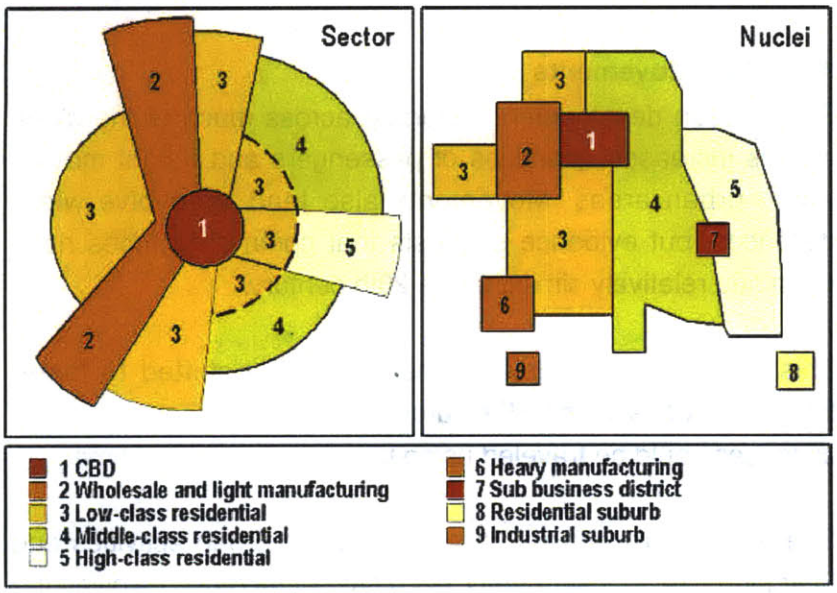
[Fig. 2.15] Von Thunen's Regional Land Use Model
Source: Adapted from Hartshorn, "Interpreting the city".

- **Von Thunen's regional land use model** is one of the oldest relationships found between transportation, urban areas and regional land use. Although this model has conceptually little relevance to urban land use, its underlying principles have been the foundation of many models where economic considerations, namely distance-decay, are shaping urban land uses. The assumption of this land use model is that agricultural land is segregated in circles around a market.

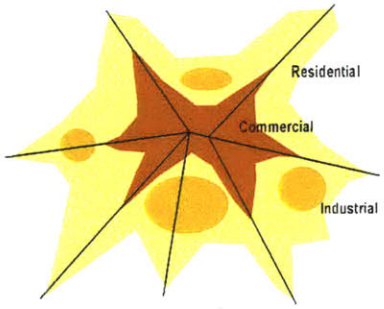


[Fig. 2.16] The Burgess Urban Land Use Model
Source: Adapted from H. Carter (1995) The Study of Urban Geography, Fourth Edition, London: Arnold.

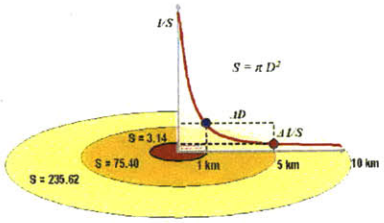
- The **Burgess concentric model** was among the first attempts to investigate transportation / land use relationships at the urban level (1925). The formal land use representation of this model is derived from commuting distance from the CBD,



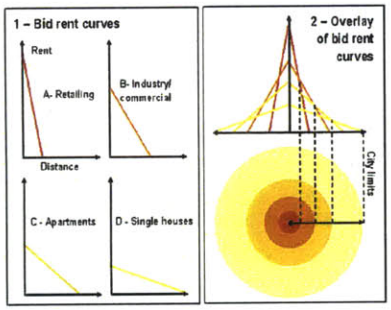
[Fig. 2.17] Sector and Nuclei Urban Land Use Representations
Source: Adapted from H. Carter (1995) The Study of Urban Geography, Fourth Edition, London: Arnold.



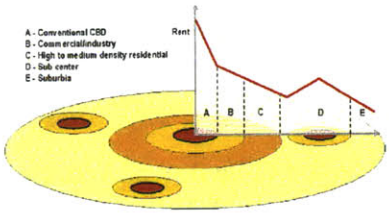
[Fig. 2.18] Hybrid Land Use Representation
Source: Adapted from Hartshorn, "Interpreting the city".



[Fig. 2.19] Land Rent Theory
Source: Adapted from Hartshorn, "Interpreting the city".



[Fig. 2.20] Land Rent and Land Use
Source: Adapted from Hartshorn, "Interpreting the city".



[Fig. 2.21] Contemporary Modifications to the Land Rent Theory
Source: Adapted from Hartshorn, "Interpreting the city".

creating concentric circles. Each circle represents a specific socioeconomic urban landscape.

- **Sector and nuclei land use models** were developed to take into account numerous factors overlooked by the concentric models, namely the influence of transport axis (1939) and multiple nuclei (1945) on land use and growth. Both representations consider the emerging impacts of motorization on the urban spatial structure.

- **Hybrid models** try to include the concentric, sector and nuclei behavior of different processes and are an attempt to integrate the strengths of each approach.

- **Land economics** was also developed to explain land use as a market where different urban activities are competing for land usage at a location. The more desirable the location, the higher its rent value. Transportation, through accessibility and distance-decay, is a strong explanatory factor in the land rent and its impacts on land use. However, conventional representations of land rent are being challenged by structural modifications of contemporary cities.

All these models are trying to assess a spatial structure of urban land use according to an array of assumptions, dominantly oriented along the friction of space and the resulting mobility. The next section addresses the specificities of urban mobility.

■ Urban Movements

Rapid urban development occurring across much of the globe implies increased quantities of passengers and freight moving within urban areas. Movements also tend to involve wider distances, but evidence suggests that commuting times have remained relatively similar in the 20th century.

This means that commuting has gradually shifted to faster transport modes, namely the automobile, and consequently wider distances could be traveled using the same amount of time.

Specific movements are linked to specific urban activities and their land use. Consequently, each type of land use involves the

generation of an explicit array of movements. This relationship is complex, but is linked to factors such as recurrence, income, urban form, spatial accumulation, level of development and technology. Urban movements are either obligatory, when they are linked to scheduled activities (such as home-to-work movements), or voluntary, when those generating it are free to decide of their scheduling (such as leisure). The most common types of urban movements are:

- **Pendular Movements**
  Obligatory movements involving commuting between places of residence and places of work. They are highly cyclic since they are predictable and recurring on a regular basis, most of the time on a daily basis.

- **Professional Movements**
  Movements linked to professional, work-based, activities such as meetings and customer services.

- **Personal Movements**
  Voluntary movements linked to the location of commercial activities, which includes shopping and recreation.

- **Touristic Movements**
  Important for cities having historical and recreational features and involves interactions between landmarks and amenities such as hotels and restaurants. They tend to be seasonal in nature or occurring at specific moments. Major sport events such as the World Cup or the Olympics are important generators of urban movements during their occurrence.

- **Distribution Movements**
  Concerned by the distribution of freight to satisfy consumption and manufacturing requirements.

The consideration of urban movements involves the perspectives of their generation, the modes and their destination:

- **Trip Generation**
  On average, an urban resident undertakes between 3 and 4 trips per day. Moving in an urban area is usually done to satisfy

a purpose such as employment, leisure or access to goods and services. Each time one of these purposes is satisfied, a trip is generated. Important temporal variations of the number of trips by purpose are observed.

- **Modal Split**
  It implies which transportation mode is used for trips in urban areas and is the result of modal choice. Modal choice depends on a number of factors such as technology, availability, travel time and income.

- **Trip Assignments**
  These involve which routes are going to be used for journeys within the city. For instance, a commuter driving a car has most of the time a fixed route. This route may be modified if there is congestion. Several factors influence trip assignment, the two most important being transport costs and availability.

- **Trip Destinations**
  Changes in the spatial distribution of economic activities in urban areas have caused important modifications to the destination of movements, notably those related to work. The central city used to be a major destination for movements, but today its share is decreasing in most areas and suburbs now account for the bulk of movements in urban areas.

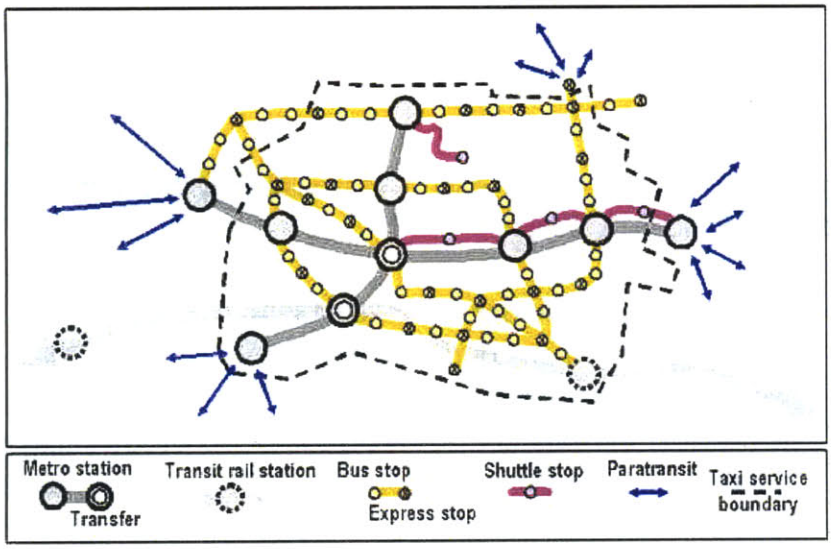
The share of the automobile in urban travel depends of several factors such as the importance of the vehicle fleet. It varies in relation to location, social status, revenue, and quality of public transit and parking availability. For mass transit low costs is a main advantage, but several social groups, such as students, the elderly and the poor are a captive market. There are important variations in mobility according to the age group and income. Consequently, in some instances modal choice is more a modal constraint. Also, important differences are observed between cities, notably between cities of developed and developing world.

In central areas, there are generally few transport availability problems because private and public transport facilities are present. However, in places outside the central core that are accessible only by the private car, a significant share of the

population is isolated if they do not own a car. Limited public transit and high costs of owning a car have created a class of spatially constrained (mobility deprived) people. They do not have access to the services in the suburb, but more importantly to the jobs that are increasingly concentrated in those areas.

2.1.3 URBAN TRANSIT

- **Transit and Urban Development**



[Fig. 2.22] Components of an Urban Transit System
Source: Adapted from Hartshorn, "Interpreting the city".

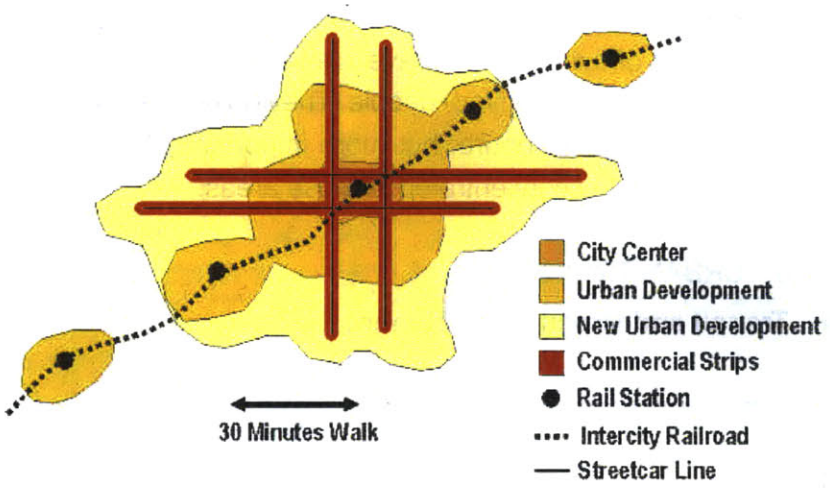
The above figure represents a hypothetical urban transit system. Each of its components is designed to provide a specific array of services. Among the defining factors of urban transit are frequency, flexibility, costs and distance between stops.

Transit is dominantly an urban transportation mode as the great majority of transit trips are taking place in large cities. The urban environment is particularly suitable for transit because it provides conditions fundamental to the efficiency of transit systems, namely high density and high mobility demands over short distances.

Since transit is a shared public service, it potentially benefits from economies of agglomeration related to high densities and from economies of scale related to high mobility demands.

Transit systems composed of many types of services, have been established to answer mobility needs. Different transit technologies and infrastructures have been implemented, resulting in a wide variety of transit systems around the world.

Reliance on urban transit as a mode of urban transportation tends to be high in Asia, intermediate in Europe and low in North America. In developed countries, there have been three general eras of



[Fig. 2.23] Transit Technology and Urban Development, Late 19th – Early 20th Century
Source: Adapted from Hartshorn, "Interpreting the city".

By the middle of the nineteenth century, many affluent families had relocated to relatively rural locations and the heads of households, typically businessmen, commuted by rail into the city centre. The "commutation" of their fares to lower prices when purchasing tickets in monthly quantities introduced the term "commuter" to the English vocabulary. During the last half of the nineteenth century, public transport improvements fundamentally changed accessibility, which in turn extended the diameter of the city and changed the shape of cities from more-or-less circular to star-shaped. Trackside suburbs developed at railway stations that were located up to 30 km away from the city centre, and linear strips of medium-density, mixed land use occurred along electric streetcar routes, creating in essence the first commercial strips.

urban development, and each is associated with a different dominant mode of transit:

- **The Walking-Horse Car Era (1800-1890)**
  The dominant means of getting around was on foot. Cities were typically less than 5 kilometers across, making it possible to walk from the downtown to the city edge in about 30 minutes. Land use was mixed and density was high (e.g. 100 to 200 people per hectare). The city was compact and its shape was more-or-less circular. The development of public transit in the form of omnibus service extended the diameter of the city but did not change the overall urban structure. The railroad facilitated the first real change in urban morphology. These new developments, often referred to as trackside suburbs, emerged as small nodes that were physically separated from the city itself and from one another. The nodes coincided with the location of rail stations and stretched out a considerable distance from the city center, usually up to a half hour train ride. Within the city proper, rail lines were also laid down and horse-cars introduced mass transit to the North American city.

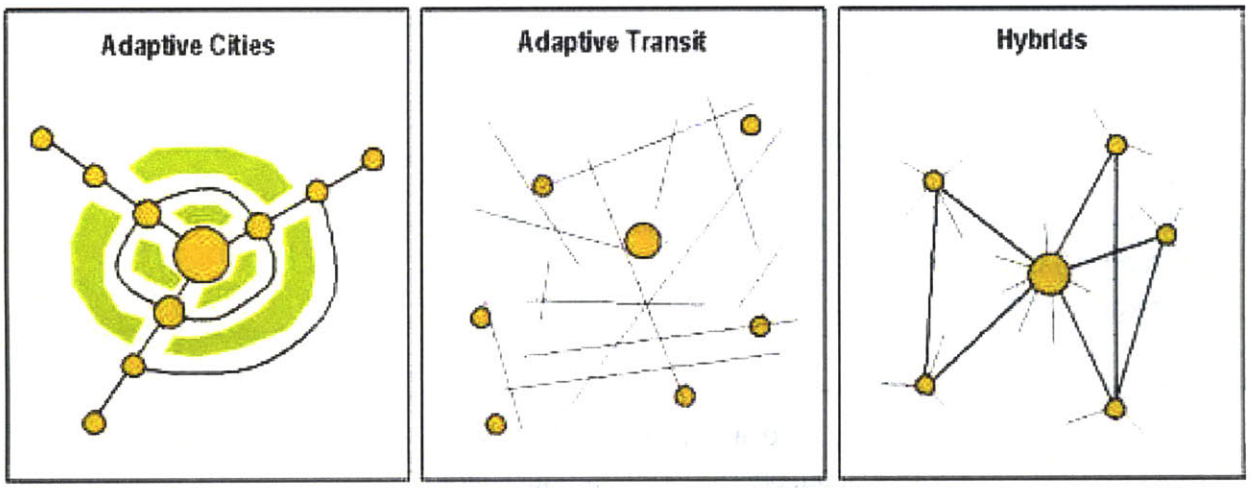
- **The Electric Streetcar or Transit Era (1890 - 1920s)**
  The invention of the electric traction motor created a revolution in urban travel. The first electric trolley line opened in 1888 in Richmond. The operating speed of electric trolley was three times faster than that of horse-drawn vehicles. The city spread outward 20 to 30 kilometers along the streetcar lines, creating an irregular, star-shaped pattern. The urban fringes became

areas of rapid residential development. Trolley corridors became commercial strips. The city core was further entrenched as a mixed-use, high density zone. Overall densities were reduced to between 50 and 100 people per hectare. Land use patterns reflected social stratification—suburban outer areas were typically middle class while the working class continued to concentrate in the central city. Segregation by ethic group also occurred.

- **The Automobile Era (1930 onward)**
  The automobile was introduced in European and North American cities in the 1890s, but only the wealthy could afford this innovation. Ownership rates increased dramatically beginning in the 1920s, with lower prices made possible by Henry Ford & revolutionary assembly-line production techniques. As autos became more common, land development patterns changed. Developers were attracted to green-field areas located between the suburban rail axes, and the public was attracted to these single-use zones, thus avoiding the evils of the industrial city. Suburban home building companies were no longer willing to subsidize privately owned streetcar companies to provide cheap access to their trolley-line neighborhoods. Transit companies ran into financial trouble, and eventually transit services throughout North America and Europe became subsidized, publicly-owned enterprises. As time went on, commercial activities also began to suburbanize. Within a short time, the automobile was the dominant mode of travel in all cities of North America. The automobile has reduced the friction of distance considerably which has lead to urban sprawl.

Since their inception in the early 19th century, comprehensive urban transit systems have had significant impacts on the urban form and spatial structure. Three major classes of cities can be found in terms of the relationships they have with their transit systems[12]:

- **Adaptive Cities**
  Represent true transit-oriented cities where urban form and urban land use developments are coordinated with transit developments. While central areas are adequately serviced



[Fig. 2.24] Transit and Urban Form
Source: Adapted from R. Cervero (1998) The Transit Metropolis, Washington, D.C.: Island Press.

by a metro system and are pedestrian friendly, peripheral areas are oriented along transit rail lines.

- **Adaptive Transit**
  Represent cities where transit plays a marginal and residual role and where the automobile accounts for the dominant share of movements. The urban form is decentralized and of low density.

- **Hybrids**
  Represent cities that have sought a balance between transit development and automobile dependency. While central areas have an adequate level of service, peripheral areas are car-oriented.

■ Local Land Use Impacts of Transit

Contemporary land development tends to precede the introduction of urban transit services, as opposed to concomitant developments in earlier phases of urban growth. Transit authorities operate under a service warrant. This as led to a set of considerations aimed at a higher integration of transit in the urban planning process, especially in North America, where such a tradition is not well established. Local land use impacts can be categorized in three dimensions of relationships with transit systems:

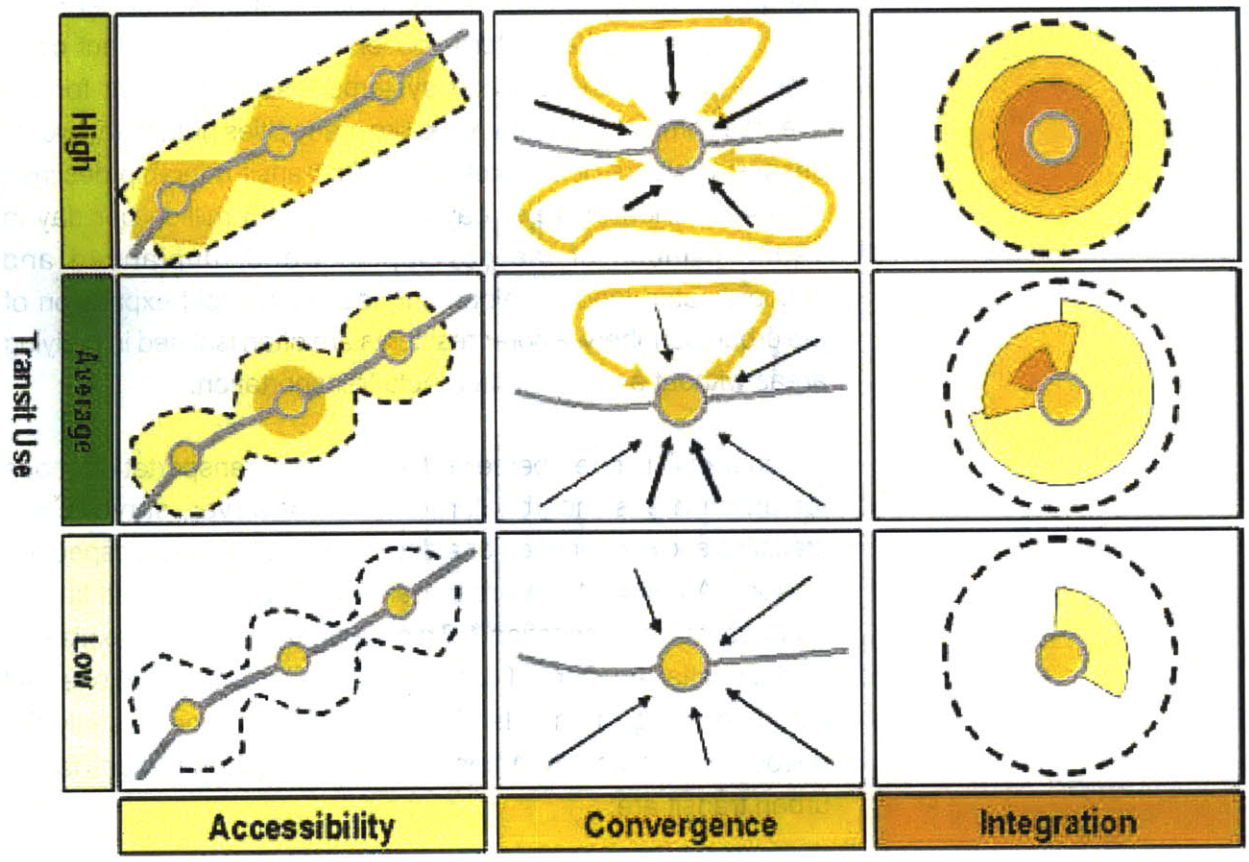
- **Accessibility**
  The sole purpose of a transit stop is to provide accessibility to the transit system, a function which often relates to simple

stops along a bus route. Land use impacts for the stop will often be minimal, if non-existent, with basic facilities to accommodate waiting time such as shelters. Accessibility defines the local market area of a transit service.

- **Convergence**
  Generally implies more important transit stops, notably rail and subway stations with terminal structures, including waiting areas and basic services. The transit station is a point of convergence of local traffic and often services more than one mode. The impacts on land use are varied and ranging from park-and-ride facilities to activities that take advantage of flows, such as restaurants and convenience stores, and possibly office activities.

- **Integration**
  Commonly related to large, multi-level terminals with well integrated high-density planning designs. Local land-use is consequently highly linked with the transit system, which supports a large share of the mobility. The terminal acts as a

[Fig. 2.25] Transit and Urban Land Use Impacts
Source: Adapted from R. Cervero (1998) The Transit Metropolis, Washington, D.C.: Island Press.



local central place with its implied hierarchy of land uses with adjacent commercial activities, with medium and low density residential areas located further away. There are different possible levels of integration, from simple terminal design with little local impact to high integration to local land use where transit is dominant.

From a transportation perspective, the potential benefits of a better integration between transit and local land uses are reduced trip frequency and increased use of alternative modes of travel (i.e. walking, biking and transit). Community design can consequently have a significant influence on travel patterns. However, such land use initiatives must be coordinated with other planning and policy initiatives to reduce automobile dependence.

■ The Urban Transit Challenge

As cities continue to become more dispersed, the cost of building and operating public transportation systems is becoming prohibitive (highways, local roads, rail systems, etc.). For instance, only about 80 large urban agglomerations have a subway system, the great majority of them in developed countries. Furthermore, dispersed residential patterns observed in car-dependent cities makes public transportation systems less convenient for the average commuter. In New York, like many cities around the world, despite 10 years of investment, public transit ridership declined from 4.8 million trips per day in 1980 to 4.3 million per day in 1992. In much of the developing world, unplanned and uncoordinated land development has led to rapid expansion of the urban periphery. Poorer residents are often isolated in outlying areas without access to affordable transportation.

Urban transit is often perceived as the best transportation mode for urban areas, notably large cities. However, surveys and statistics show stagnation or a decline of public transit, especially in North America. Most urban transit developments had little, if no impacts on congestion[13]. This paradox is partially explained by the spatial structure of contemporary cities which are oriented along servicing the needs of the individual, not necessarily the needs of the collectivity. Among the most difficult challenges facing urban transit are:

- **Decentralization**
  Public transit systems are not designed to service low density and scattered urban areas that are increasingly dominating the landscape. The greater the decentralization, the more difficult and expensive it becomes to serve urban areas with public transit.

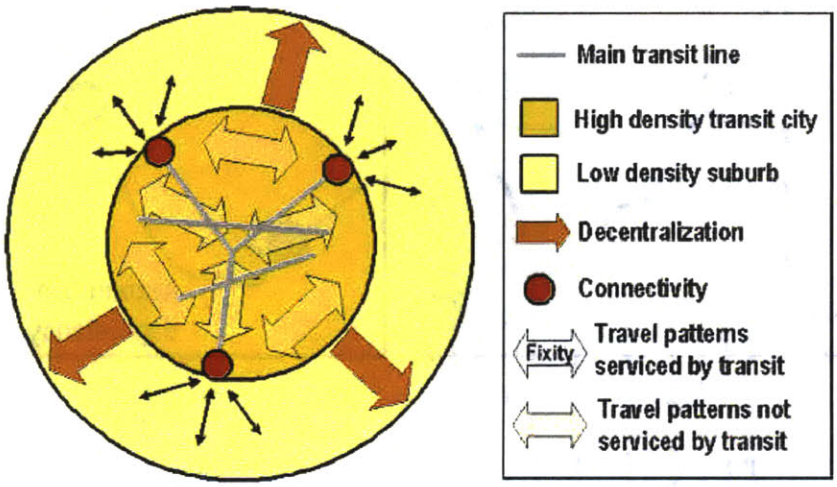
- **Fixity**
  Several public transit systems, notably rail and metro systems are fixed, while cities are dynamical entities. This implies that travel patterns tend to change and that a transit system built for servicing a specific pattern may face "spatial obsolescence" in time.

- **Connectivity**
  Public transit system is often independent from other modes and terminals. It is consequently difficult to transfer passengers from on system to the other.

- **Competition**
  In view of cheap and ubiquitous road transport systems, public transit faces strong competition. The higher the level of automobile dependency, the more inappropriate the public transit level of service. The public service being offered is simply outpaced by the convenience of the private car.

2.1.4 URBAN TRANSPORT PROBLEMS

■ **Geographical Challenges Facing Urban Transportation**



[Fig. 2.26] Challenges of Urban Transit
Source: Adapted from R. Cervero (1998) The Transit Metropolis, Washington, D.C.: Island Press.

The figure presents some challenges the transit system of a city may face. Decentralization and suburbanization have created an urban space of lower density that cannot be efficiently serviced by mass transit systems outside specific bus routes. Under such circumstances, transit is limited to a part of the city and a city-wide service becomes prohibitive.

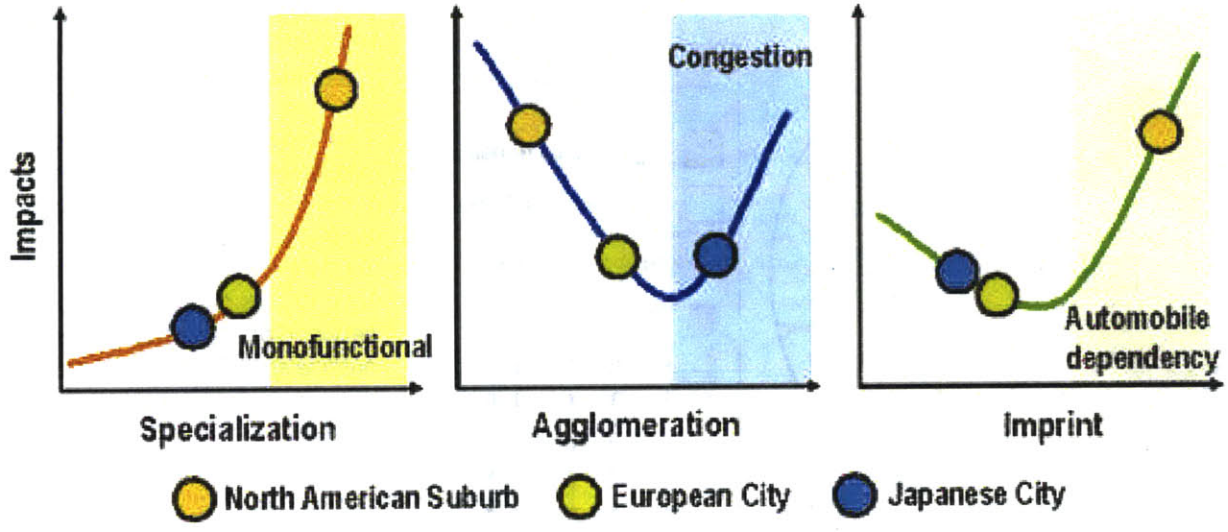
Cities represent places having a high level of accumulation and concentration of economic activities. They are complex spatial structures to be supported by transport systems. The most important transport problems are often related to urban areas, especially when urban transport systems, for a variety of reasons, cannot satisfy the numerous requirements of urban circulation. Urban productivity is highly dependent on the efficiency of its transport system, notably to move labor, consumers and freight between several origins and destinations. The growing complexity of cities has been accompanied by a wide array of urban transportation problems, some ancient like congestion, and others new like environmental impacts. Among the most notable are:

- Traffic congestion and parking difficulties.
- Public transport crowding and off-peak inadequacy.
- Difficulties for pedestrians.
- Environmental impacts and energy consumption.
- Accidents and safety.
- Land consumption.
- Freight distribution.

Urban transportation aims at supporting transport demands generated by the diversity of urban activities in a diversity of urban contexts. This diversity is particularly notable between developed and developing countries. Cities are important generators and attractors of movements, which have created a set of geographical paradoxes that are self-reinforcing such as:

[Fig. 2.27] Geographical Paradoxes behind Urban Transport Problems
Source: Adapted from Hartshorn, "Interpreting the city".

The figure below illustrates the negative impacts of three simplified urban settings concerning specialization, agglomeration and imprint.



- **Spatial Specialization**
  The differentiation between land uses is a generator of movements as people and freight move from several origins and destinations. Thus, the more complex the land use patterns in a city, the more complex their associated movements will be. Also, efficient and affordable transportation will enhance the segregation of land uses.

- **Spatial Agglomeration**
  Since cities benefit from agglomeration economies. Activities are located nearby each-others benefit from increased interactions, which also decrease transport costs. However, the agglomeration of movements in a limited area creates traffic, which renders movements more expensive. It can reach a point where the advantages of agglomeration are overthrown by congestion.

- **Spatial Imprint**
  The main goal of transportation is obviously to overcome the friction of space by providing a level of mobility. However, transportation, like any urban function, consumes space and thus has a spatial imprint. While space is the rarest (and consequently the most expansive) in urban areas, transportation requirements are at their highest levels. A compromise is thus sought between the availability of space devoted to transportation and the desired mobility.

There are several dimensions to the urban transport problem, most of them linked with the over emphasis on the usage of the private car.

- **Automobile Dependency**

Accessibility is a positive element because each individual, regardless of means and income, should have equal access to basic goods and services. However, mainly due to the automobile, accessibility can also be a negative element. The use of automobiles obviously produces a wealth of advantages such as performance, comfort, status, speed, and convenience. These advantages jointly illustrate why car ownership continues to grow worldwide, especially in urban areas. Several factors influence

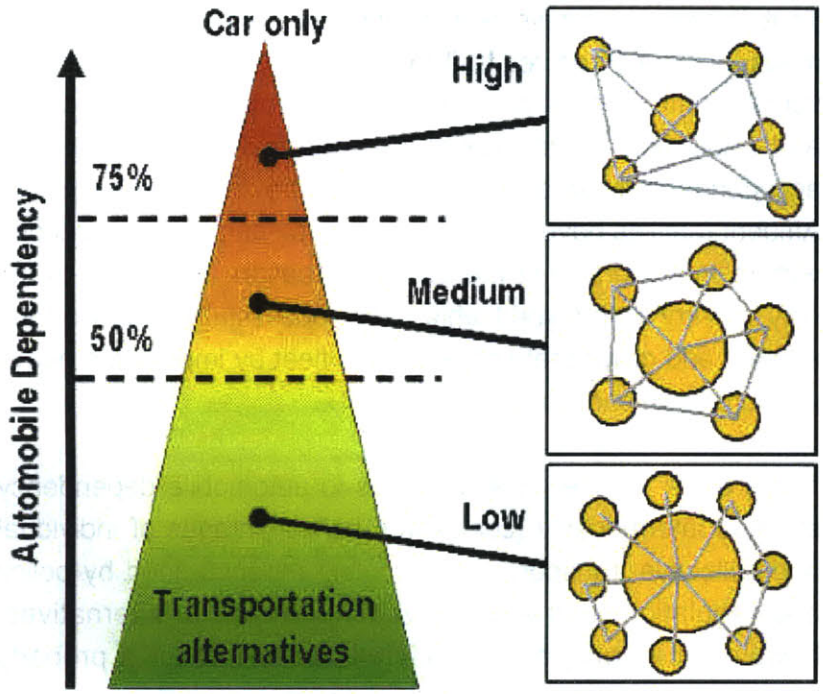
the growth of the total vehicle fleet and motorization, such as sustained economic growth (increase in revenue and quality of life), daily constraints and peripheral urban growth. The acute growth in the total number of vehicles encourages difficulties in traffic circulation. Such difficulties have a tendency to multiply and provoke further congestion at peak traffic hours on major thoroughfares, in business districts and throughout the city.

The intensity in interactions varies as a function of city size, wealth and the spatial distribution of activities. Within the urban landscape, this fact is illustrated by the increased use of automobiles as a support to urban mobility. In time, a situation of automobile dependency emerged with its associated land use patterns and limited alternatives to urban mobility other than the car. Two major factors contributing to dependency are noted:

- **Under Pricing and Consumer Choices**
  Most road infrastructure is subsidized as they are considered a public service. Consequently, drivers do not bear the full cost of car usage. This is reflected in consumer choice, where car ownership is a symbol of status, especially in developing countries. Single home ownership also reinforces car dependency.

- **Planning and Investment Practices**
  Planning and the ensuing allocation of public funds aim towards improving road and parking facilities in an ongoing attempt to avoid congestion. Other transportation alternatives tend to be disregarded. In many cases, zoning regulations impose minimum standards of road and parking services and de facto impose a regulated car dependency.

There are several levels of automobile dependency with their corresponding land use patterns and alternatives to mobility. Among the most relevant indicators of automobile dependency are the level of vehicle ownership, per capita motor vehicle mileage and the proportion of total commuting trips made using an automobile. A situation of high automobile dependency is reached when more than three quarters of commuting trips are done using the automobile. For the United States, this figure was 88% in 1992.



[Fig. 2.28] Levels of Automobile Dependency
Source: Adapted from Hartshorn, "Interpreting the city".

Automobile dependency ranges from low where a set of transportation alternatives are offered, to high where little if no alternatives are available outside the car. When automobile trips exceed 75% of all personal trips a situation of high dependency is observed. Automobile dependency is also linked with the urban spatial structure as cities with a low level of car dependency tend to be centralized with high levels of density while cities with a high level of car dependency how low levels of centrality and density.

In the 1960s many cities in North America and Europe were being adapted to automobile circulation. Motorized transportation was seen as a powerful symbol of modernity and development.

However, from the 1980s, several cities were trying to limit automobile circulation by a set of strategies including[14]:

- **Dissuasion**
  Although car circulation is permitted, it is impeded by regulations and physical planning (Berne and Zurich).

- **Prohibition of Downtown Traffic**
  During most of the day the downtown area is closed to car circulation but deliveries are permitted during the night. Such strategies are often undertaken to protect the character and the physical infrastructures of a historical city (Bologna and Milan).

- **Tolls**
  Imposing tolls for parking and entry to some parts of the city (Singapore and New York).

Tentative solutions have been put forth such as transport planning measures (synchronized traffic lights, regulated parking), limited vehicle traffic in selected areas, the promotion of bicycle paths and public transit. In Mexico City, vehicle use is prohibited according to license plate numbers and the date (even-uneven). Affluent families have solved this issue by purchasing a second vehicle thus worsening the existing situation. Singapore is the only country in the world which has successfully controlled the amount and growth rate of its vehicle fleet by imposing a heavy tax burden on car owners.

There are a number of alternatives to automobile dependency such as intermodality (combining the advantages of individual and collective transport) or carpooling (strengthened by policy and regulation by the US government). These alternatives, however, can only be partially executed without a properly organized structure and public awareness.

- **Congestion**

Congestion occurs when transport demand exceeds transport supply in a specific section of the transport system. Under such circumstances, each vehicle impairs the mobility of others. The last decades have seen the extension of roads in rural but particularly in urban areas. Those infrastructures were designed for speed and high capacity. Investments came from diverse levels of government with a view to provide accessibility to cities and regions. There were strong incentives for the expansion of road transportation by providing high levels of transport supply. This has created a vicious circle of congestion which supports the construction of additional road capacity and automobile dependency. Urban congestion mainly concerns two domains of circulation, often sharing the same infrastructures:

- **Passengers**

  In all industrialized countries, income has significantly increased to the point that one car per household or more is a common car ownership figure. It is acknowledged that cars convey flexibility in terms of origin, destination and time of travel. The car is favored at the expense of other modes for most trips, notably for single occupancy commuting.

- **Freight**
  Several industries have shifted their reliance from other modes (rail) to trucking, increasing the usage of infrastructure with large vehicles. Since cities are the main destination for freight (either for consumption or transfer to other places) trucking is linked with congestion in urban areas.

Infrastructure provision was not able to keep up with the growth in the number of vehicles, even more with the total number of vehicles-km. During infrastructure improvement and construction, capacity impairment favors congestion. Important travel delays occur when this limit is reached or exceeded. Large cities are now congested most of the day, and congestion is getting more acute. Another important consideration concerns the parking of vehicles, which consumes a large amount of space. In car dependent cities, this can be very constraining as each economic activity requires an amount of parking space proportional to their level of activity.

Daily trips can be either "mandatory" or "voluntary". The former is often performed within fixed schedules while the latter comply with variable schedules. The former is mainly responsible for the peaks in circulation flows. The spatial convergence of these flows causes a surcharge of transport infrastructures up to the point where congestion can lead to the total immobilization of traffic. Not only does the massive use of the automobile have an impact on traffic circulation, but it also leads to the decline in public transit efficiency. These sometimes play a social role by allowing certain population strata to travel despite limitations in income.

In some areas, the car is the only mode for which infrastructure is provided. This implies less transit shares and less capacity for using alternative modes and difficulty to be served by transit and other infrastructure in a cost-effective way. At some levels of density, no public infrastructure investment can be justified in terms of economic returns. Longer commuting trips in terms of average travel time, the result of fragmented land uses. Convergence of traffic at major highways that serve vast low density areas with high levels of car ownership and low levels of car occupancy. The result is energy wasted during congestion and supplementary commuting distances.

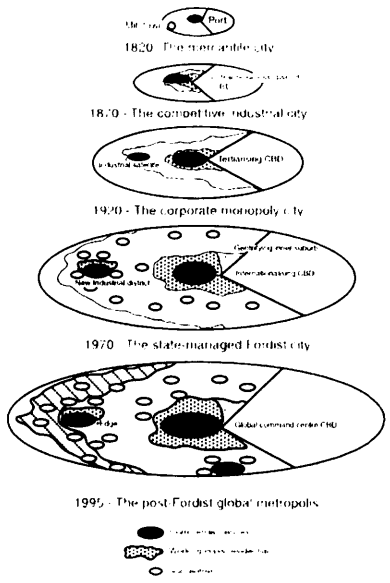
2.2 SUSTAINABLE TRANSIT DEVELOPMENT

2.2.1 URBAN SPRAWL

Urban sprawl is a phenomenon that has affected the form of our cities from the 1920's till date. Over the period of 1920 – 70 the proportion of the US population living in urban places of 5,000 or more increased from 47 percent to 70 percent[15]. In geographical terms the major changes in the distribution of the urban population were:

- The emergence of super – metropolitan urban areas.
- The spread of metropolitan urban development across most of the continent.
- The growth of urban areas beyond the old central city.

These spatial trends were facilitated by transport developments; including the wide spread use of the automobile and construction of the interstate highway system. Thus one sees that the morphology of such cities has a distinctive character: they have been shaped by the development of transportation, have no need for a dominant downtown area and sprawl over the landscape in a low density form of development towards the edge of the city. One would observe that this form of the western city has become predominant and is shown in the table on the opposite page.



[Fig. 2.29] Evolving urban form of the North American City
Source: Pacione, "Urban Geography".

■ Urban Sprawl Definitions

- While there's no universally accepted definition, the Vermont Forum on Sprawl concisely defines sprawl as "dispersed development outside of compact urban and village centers along highways and in rural countryside."
- Anthony Downs, at a May 1998 Transportation Research Conference, identified ten "traits" associated with sprawl:
  - Unlimited outward extension
  - Low-density residential and commercial settlements
  - Leapfrog development
  - Fragmentation of powers over land use among many small localities
  - Dominance of transportation by private automotive vehicles
  - No centralized planning or control of land-uses
  - Widespread strip commercial development
  - Great fiscal disparities among localities
  - Segregation of types of land uses in different zones

	Urban Functions	Transport Technology	Transportation System	Urban Form
Stage 1: Pre-industrial	Defense, marketing, political - symbolic, craft industry	Pedestrian, draught animal	Route convergence, radial	Compact
Stage 2: Early industrial	Basic industries, secondary manufacturing	Electric tram, street car, public transport	Radial improvements, incremental additions	High - density suburbanization, radial form
Stage 3: Industrial	Broadening industry, tertiary service expansion	Motor bus, public transport, early cars	Additional radials, initiation of 'ring roads' (incomplete)	Lower - density suburbanization, industrial centralization
Stage 4: Post-industrial	Addition of quaternary activities	Towards universal car ownership	Integrated radial and circumferential road network	Low - density suburbanization, wide spread functional decentralization

[Table 2.1] The relationship between transportation and urban form in western cities
Source: Pacione, "Urban Geography".

- Reliance mainly on the trickle-down or filtering process to provide housing to low-income households

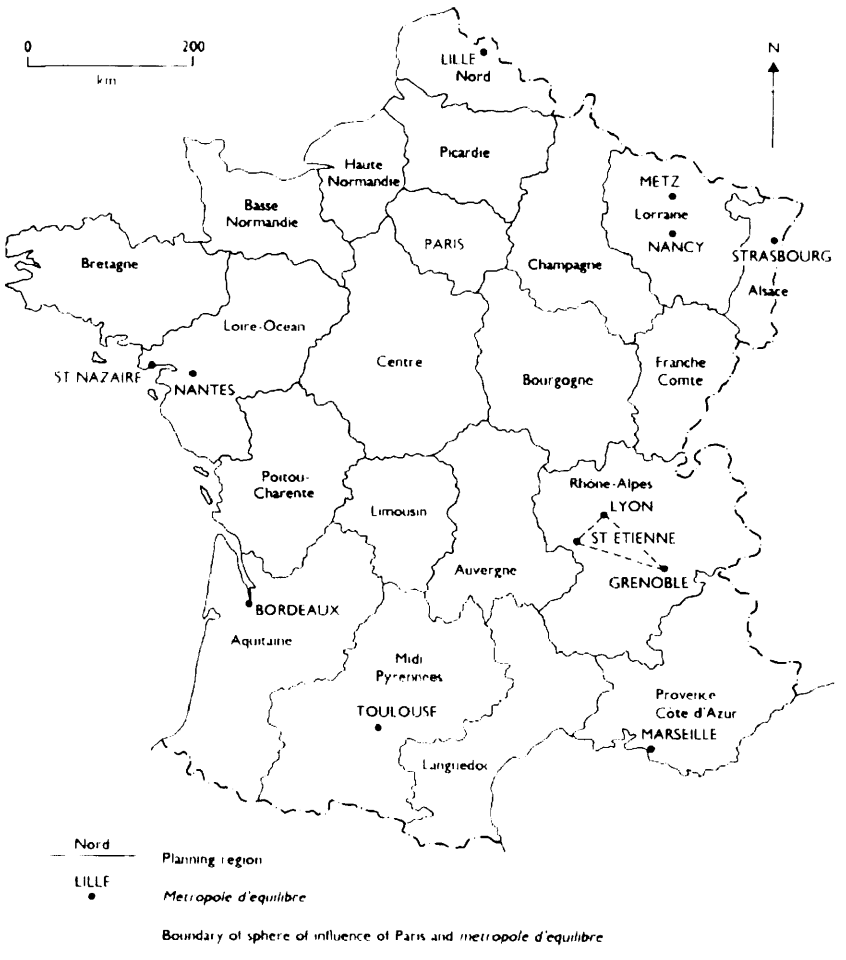
If cities grow in an uncontrolled way then diseconomies and disadvantages are an inevitable outcome. In the cities of the developed world, uncontrolled growth results in long journey to work, traffic congestion, and heavy pollution and for inner city dwellers long journeys to urban fringe countryside. In developing countries like India where expansion is taking place rapidly, housing, traffic, water supplies, telecommunications and electricity services are subject to frequent breakdown because the existing infrastructure is unable to cope, and scarce resources make improvement and expansion of systems virtually impossible.

■ Strategies to Counter Urban Sprawl

Two strategies that have been used to counter urban sprawl are, deconcentration and containment of urban growth. Following is a description of each of them with examples.

■ **Deconcentration of Urban Growth:** an example of this strategy can be seen in the urban planning tradition in France. The dominance of Paris in France (it is six times as large as the next biggest city) has always been controversially discussed, and a 1960 plan for the capital proposed a complete stop on its future physical growth. This proposal was unrealistic in nature and was superceded by another plan in 1965 that proposed the following:

- It assumed a continued 4 percent annual growth of population, effectively doubling Paris's population in 20 years, but with a deliberate slowing down of the rate of growth that it was assumed would occur if there were no restrictions, in order to promote urban growth in the provinces.
- The rate of migration was to be checked by channeling government investment into selected provincial cities and encouraging private investment there.



[Fig. 2.30] The French *metropoles d'equilibre*
Source: after Hall, 1974

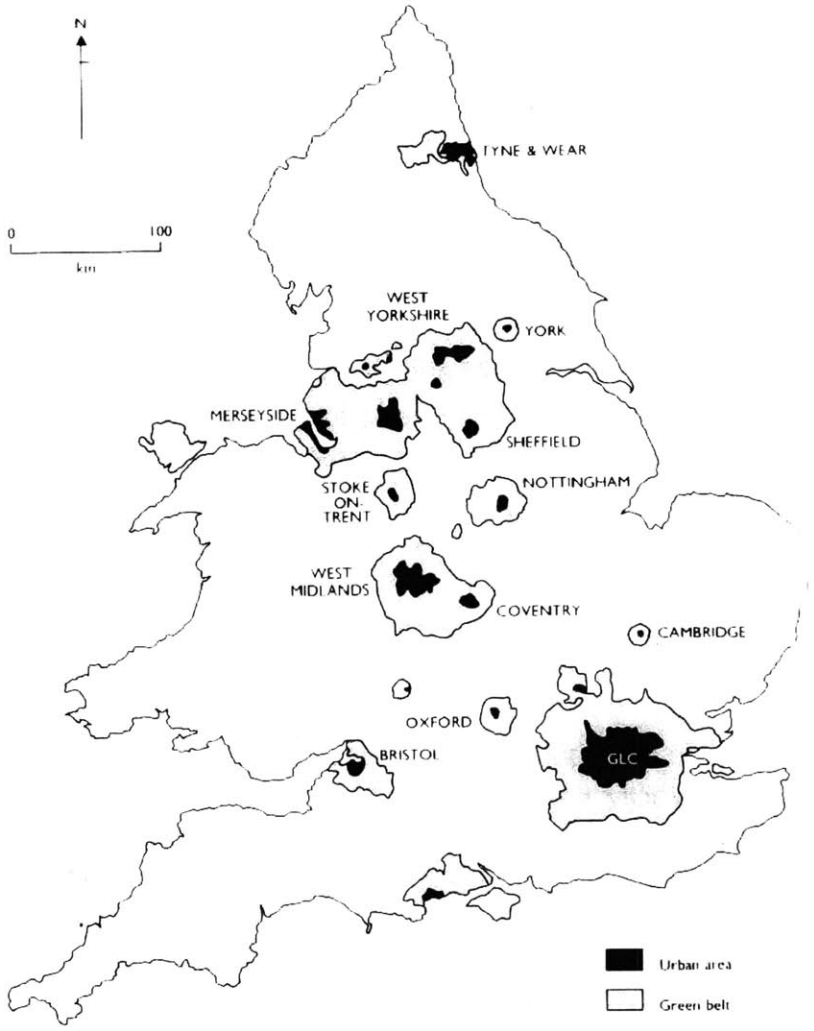
- Eight major urban agglomerations were selected to act counterweights to the pull of Paris. They were also designed to act as growth poles in their own regions.
- Paralleling the planned development of these provincial centers, a number of new cities were created in the outer Paris region, to perform the same role as the eight major urban agglomerations. They have also grown rapidly thus diminishing the potential impact of the provincial centers.

From the results of the 1975 and 1982 French census one sees, that although Paris grew much less quickly than its main provincial rivals between 1968 and 1975, a more significant trend was the population decline of Paris and two of the regional centers between 1975 and 1982, and the relative stagnation of other provincial centers in the same time period. This suggests that France's major urban agglomerations have become victims of the counter urbanization trend that has also been seen in USA.

Greater personal mobility, the decentralization of industrial and commercial activity and the general better quality of life found in smaller settlements are all influencing population distribution and lifestyles. If counter urbanization continues then the primacy of Paris may not be the problem it once was. Importantly one can say that channeling of investment towards major provincial urban centers in order to equalize growth looks like an outdated strategy.

■ **Containment of Urban Growth:** examples of urban containment measures can be seen in England and Wales based on the idea of green belts. A green belt is essentially an area which can be many kilometers wide, in which non-agricultural or non-recreational developments are severely restricted. Green belts thus shape or preserve the general pattern of urban growth, arrest outward expansion, prevent coalescence of neighboring urban areas and preserve accessible urban fringe countryside for public enjoyment. They may also help in the rejuvenation of inner areas by restricting the supply of peripheral development land. Some of the disadvantages of the green belt strategy are the following:

- They restrict the supply of developable land thus raising land prices and causing high housing densities.



[Fig. 2.31] Green belts in England and Wales 1986, approved by statute
Source: Munton, 1986

- Also unlike the planners had suggested green belts do not serve as recreation spaces for populations throughout the urban area constrained by them. It is mostly used by the local residents.

The concept of green belts is closely linked with the development of "new towns": new or enlarged existing centers designed in part to act as overspill centers beyond the green belt. This idea has been particularly well developed around London with the development of towns like Northampton and Milton Keynes.

■ Policies in the US to Control Urban Sprawl

Following is a description of some of the policies and initiatives being carried out in the US to control urban sprawl:

Policy / Initiative	Purpose
Urban Growth Boundary	To set a geographical limit to the expansion of the metropolitan area so as to encourage infill development and densification of the area within the boundary.
New legislation like Intermodal Surface Transportation Efficiency Act	Attempt by the federal government to give the state and local authorities more flexibility in: Using federal transportation funds. Encourage coordinated transportation and land use planning at the metropolitan level.
New Urbanism	Create neo-traditional villages with denser, more mixed land uses that encourage lesser automobile dependence. The environments in these villages are to be transit - oriented.
Smart Growth	Promotes the following efficient use of land resources through the following: Infill development Brownfield redevelopment Denser, mixed land uses Walkable communities Transit oriented development
Transit-Oriented Development (TOD)	This is similar to smart growth and focuses more on improving transit ridership by creating a transit oriented urban form.
Urban Core Revitalization	Attempts to retain the middle and upper middle class, as well as businesses in the city. The policy may also try to relocate these from the suburbs into the city. This is tried to be achieved through the following programs: Economic incentives Improvement to the physical appearance of the city Better transportation system Reduce crime level

[Table 2.2] Table describing some of the policies in the US to control sprawl
Source: Author

2.2.2 TRANSIT ORIENTED DEVELOPMENT

The concept of transit-oriented development has largely emerged in the US, for the auto-oriented post-Second World War suburbs. This form of development advocates a type of suburban community designed in neo-traditional terms with a mix of land uses, moderate residential densities, pedestrian circulation, and

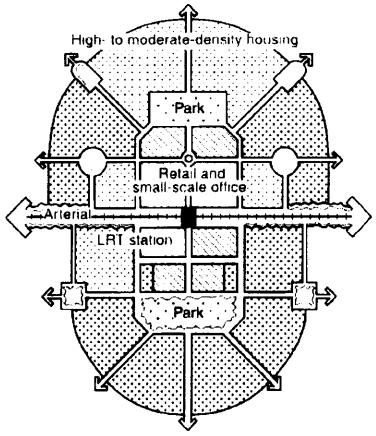
small offices and shops clustered around a transit station. The first such community was developed at stations on the BART system, but similar nodes have developed along other transit routes, including the line of the Washington Metro rail system in suburban Virginia and Maryland.

■ The Three Ingredients of Transit Oriented Development

- **Density:** land use densification around transit stations so as to concentrate people, residences and jobs near transit stations, thus encouraging people to commute by transit.
- **Design:** urban design measures and elements which help improve the environment around the station for pedestrians and bicyclists.
- **Diversity:** mixed land use around transit stations so as to reduce trip chaining by providing a mix of residential and commercial uses near stations. Helps create a walkable community for people who live in the surrounding area.

■ Benefits of Transit Oriented Development

- Provides for a more self sufficient community around the development node.
- It leads to positive environmental effects like – reduces air pollution (because of the less number of automobile trips) and congestion.
- Promotes efficient land use and hence results in conservation of open spaces in other parts of the community.
- It is good for equity, as it makes jobs accessible for low income people. Also reduces transportation costs for low income people and hence increases their monthly savings.



[Fig. 2.32] Plan of a transit oriented community
Source: Pacione, "Urban Geography".

■ Government Policies for Transit Oriented Development

Government can encourage more private sector involvement in developing sites around transit stations by assembling parcels for private developers. This would attract developers as they will save time and money by not negotiating with several different owners and will start with a consolidated larger parcel of land.

Public agencies can change zoning regulations around transit stations so as to encourage high densities and mixed land uses. There could also be regulations which make it mandatory for

developers to build shopping malls etc. only near transit stations. The public development agency can also encourage transit oriented development by allowing higher floor area ratio on sites close to the transit.

Economic incentives, such as tax breaks could be given to builders who build high density mixed-use development near transit. The government can also participate in the development process by forming a strategic partnership with the private developer.

Transit oriented development is advantageous to the government as little direct public investment is required and most of the expenditure is borne by private developers. The government has to provide attractive incentives and make conditions favorable for development to encourage the private sector to build near transit.

2.2.3 TRANSPORTATION AND THIRD WORLD URBAN FORM

Most cities in the third world are undergoing rapid urbanization and as a result form some of the fastest growing cities in the world today. The pressure on infrastructure and land resources are much more in these cities as compared to those in developed countries. This is mainly due to high densities in the city, both in terms of dwelling units and population per given area.

Interestingly the high density development is reflected in the built form of the city as low rise high density instead of high rise buildings. Factors such as affordability, incremental growth, migration and family size are some of the reasons for the low rise high density built form.

Urban growth of developing world cities happens mainly due to two reasons:

- Constant increase in population in the city as a result of large migration flows from rural areas to the outskirts of the city
- Poor people being displaced from the center of the city due to the lack of affordable housing.

Both the migrant and the displaced population usually settle in shantytowns on the outskirt of the city. Over time they are provided with services and are included in the city region's urban boundary.

This development pattern over time leads to not only sprawl but also to an inequitable, unsustainable city structure which has both social and environmental concerns.

Cities which do not have efficient transit networks connecting the periphery to the city center see a phenomenon in which large numbers of low income group people squat in the city center so as to be close to their employment base.

With most public development agencies in these cities not being able to cope with the influx of people it leads to a chaotic central city with mixed land uses. These uses would include residential (predominantly low income), small scale commerce (formal and informal), small-scale industry and government services.

Development in most cities is guided by a master plan and zoning codes. The implementation of such plans is poor because of poor institutional capacity, lack of public participation, no coordination between different agencies and as a result of this unplanned growth occurs leading to illegal settlements, squatter settlements, urban sprawl and failure of infrastructure.

2.2.4 TRANSIT ORIENTED DEVELOPMENT IN THIRD WORLD CITIES

Transit oriented development (TOD) has been restricted mostly to cities in the developed world. This thesis presents the case that TOD if implemented will be as successful if not more in developing world cities like Delhi. The following conditions encourage one to think for the success of TOD in cities like Delhi:

- Rate of urbanization is higher.
- Lack of public transport and low affordability levels of people for personal vehicles.
- Non dominant mode share of automobiles.
- Higher densities in cities because of the nature of built form and also family sizes.
- Construction quality is often poor; hence existing buildings can be easily replaced for planned new development.
- Since urbanization is an ongoing process the city can formulate policies which encourage transit oriented development. This way it can shape the entire metropolitan area.

- Other than tapping new land banks, TOD can help increase the density of already existing areas which may be low income or are in need of infill development.

In summary, coordinated transportation and land use planning in Delhi should aim to control sprawl by:

- Concentrating low income people at nodes of high density and along corridors of high density that will justify investment in high capacity transit that has lower costs per seat and can charge lower fairs.
- Making the best use of the land around the transit stations by promoting high density, mixed use development.

Successful implementation of TOD requires a concerted interdisciplinary effort, coordination at the metropolitan level and enforcement of TOD policies. Most third world cities like Delhi suffer from these institutional weaknesses. Hence for TOD to be a success in such cities, it will be important that the government makes suitable institutional adjustments, and that there is close coordination between a determined political leadership and a professional team of planners.

Notes

[1] United Nations, World Urbanization Prospects: The 2001 Revision
[2] Ibid
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03

EVOLVING CITY FORM OF DELHI

[Fig. 3.1] Fabric-Lutyen□s Delhi
Source: Rotch Visual Collection

[Fig. 3.2] Sprawl-Lutyen□s Delhi
Source: P. Verma

[Fig. 3.3] Fabric-Old Delhi
Source: Rotch Visual Collection

[Fig. 3.4]High Density-Old Delhi
Source: P. Verma

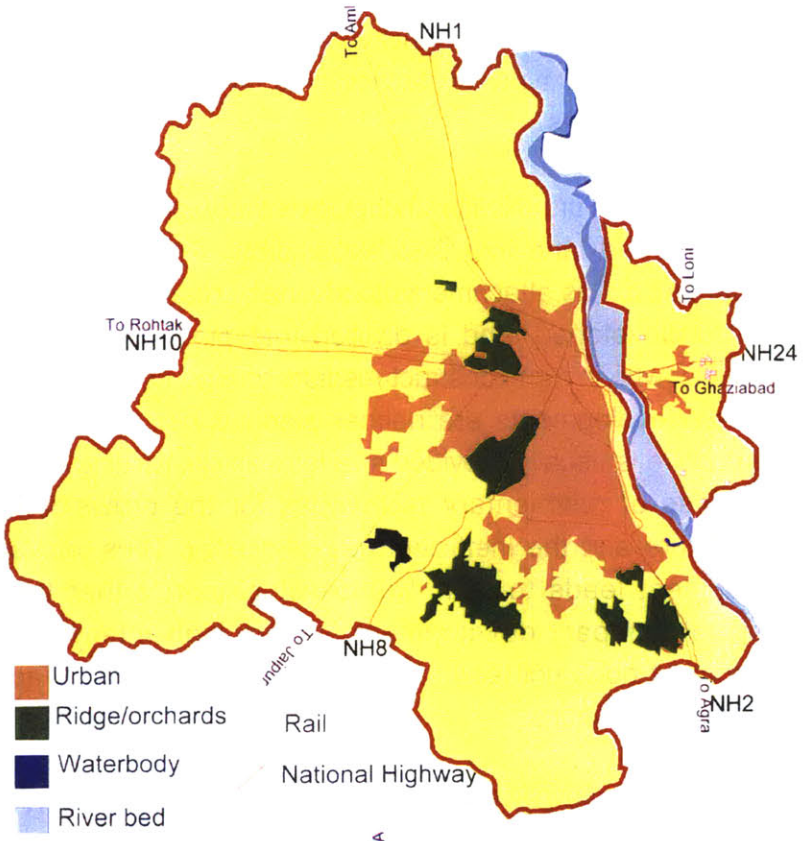
3.1 URBANIZATION TRENDS

The present city form of Delhi would be best described as one which is opposite to that of a compact city. It has low gross residential densities in the inner areas and higher gross densities in the outer areas. Gross densities are at least four times higher in outer areas than in the inner city. Intensity of development is also low. The city is composed of single or double storey residential buildings in most of its inner city areas, while four to eight storey buildings are common in the outer areas. Such outer areas may at the urban fringe or outsides the urban area boundary in neighboring satellite cities.

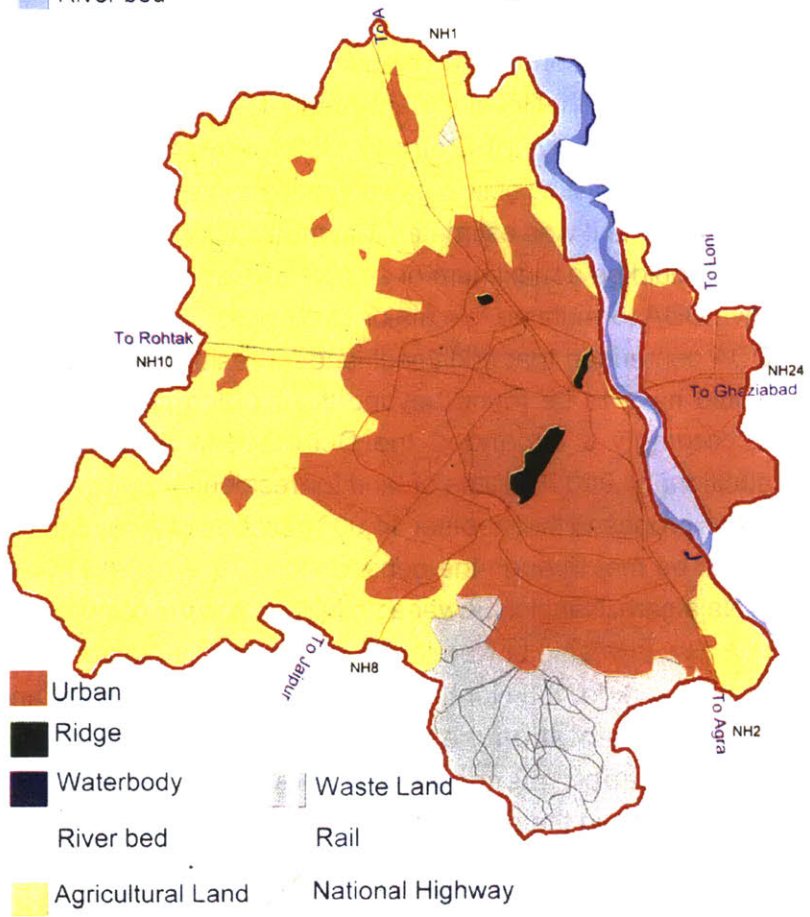
The evolution of the present city form can be explained by examining the political events of the first decade of the twentieth century and the subsequent policies of the Delhi Development Authority which has led to the unique process of urbanization of the city of Delhi.

In the design of New Delhi, the British were keen to impose a statement of imperial grandeur, order and authority. As a result of this vast low density residential areas were developed in New Delhi by British planners and architects. Lutyens□Delhi was originally planned to contain only 140 bungalows[1] and none of the bungalows was to be more than a single storey[2]. Also large spaces were occupied by low density uses like military barracks now used as central government offices and low rise commercial areas such as Connaught Place.

The process of urbanization changed after independence in 1947. This has been largely due to the migration of people from rural to urban areas, primarily in search for better employment. Rural to urban migration contributed about 30% to urban growth between 1981 and 1991 in India[3]. However this figure was more than 50% for the four Indian mega cities[4]. It is estimated that on average 1,000 people migrated to Delhi everyday between 1981 and 1991[5]. As a result of this the squatter population increased from 493,545 in 1981 to 1,296,720 in 1991, almost 263% growth in a decade[6]. As most migrants did not have jobs they were forced to squat on any vacant land. This process having been repeated year after year has given rise to numerous squatter settlements and slums in the city. The squatters, in particular have built low rise and less

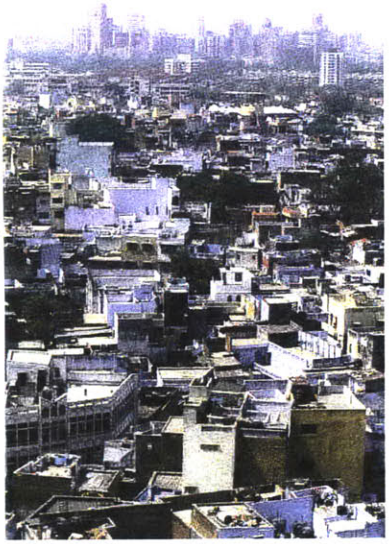


[Fig. 3.5] Delhi in 1958
Source: NCRPB

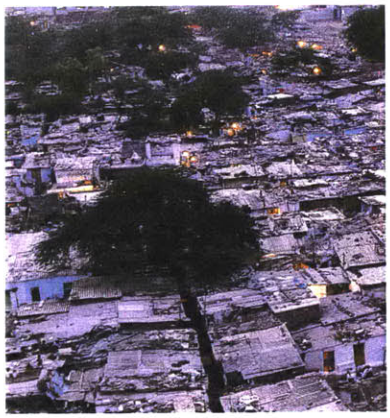


[Fig. 3.6] Delhi in 1986
Source: NCRPB

[Fig. 3.7] Plotted Development-Present Delhi
Source: P. Verma



[Fig. 3.8] Resettlement Colonies - Present Delhi
Source: P. Verma



[Fig. 3.9] Squatter Settlements-Present Delhi
Source: P. Verma

compact residential developments in various parts of the city. The built form of these types of settlements largely constitute of temporary structures.

Another feature of urbanization in the city is the illegal sub-division of undeveloped land into residential plots. These kinds of development act as attachments to planned urban areas where vacant undeveloped land is divided into plots and sold to individuals, who in turn construct medium to high rise buildings. As these developments are neither planned nor authorized, infrastructure is usually provided at a later stage, leading to the interim use of rudimentary techniques for the provision of infrastructure and the inefficient use of energy. Thus intense development leads to slum-like development, rather than beneficial compact development, as the high intensity of development does not lead to the optimum use of social and physical infrastructure.

3.2 DELHI GOVERNMENT'S POLICIES TO CONTAIN THE GROWTH OF THE CITY

In an attempt to contain the boundary of Delhi from further expanding the Delhi Development Authority (DDA) proposed a compact city policy for Delhi in 1990. Proposals for the densification of existing built form were made as part of the revised Master Plan and it was estimated that the total land requirement by 2001 would be a maximum of 24,000 hectares. As part of the initiative DDA formulated five major strategies:

- DDA contended that additional land for residential purposes would have to be found beyond the existing city structure. Accordingly it expanded the Delhi Urban Area with an additional 4,000 hectares of land for residential purposes
- It was proposed that another 14,000 hectares of land required would be met through the densification of the census towns of Najafgarh, Nangloi, Bawana and Alipur, and the construction of a new township at Narela. As of present the planning and design work for the Narela Township has been finished and its implementation has been started. However, no intensification mechanisms have been devised for densification in the census towns.
- DDA argued that developed land would always remain limited when compared with the requirements of the exploding

population's housing and other land related needs. It was thus proposed that the remaining land requirement of 6,000 hectares would be met by increasing the 'holding capacity' of the Delhi Urban Area of 1981. This meant that DDA had inadvertently given the go-ahead to property owners selectively to increase densities by intensification without securing planning permissions. The people knew that DDA would subsequently legalize these illegal developments.

- DDA also proposed that in future it would primarily encourage group housing rather than plotted developments, in order to accommodate more households on the same amount of land. It is expected that a gross density of 350-400 pph will be achieved.
- Lastly a 'containment policy' was introduced in which DDA argued that it will strive to create self-contained planning divisions. It was expected that people will not need to make inter-division trips for purposed like work, education, leisure and recreation.

Other initiatives that have been taken since 1990 as part of the containment policy include the setting up commissions to examine height restrictions and the densification of Lutyens' Delhi.

In the second half of 1999, DDA concluded a major design competition for residential sites in Dwarka, Tehkhand and Vasant Kunj. The entries which were finally selected for implementation showed a new approach by DDA for development, as they all proposed high rise development instead of the low to medium rise development pattern which is usually followed by DDA.

For the new Master Plan that is currently being prepared DDA has committed itself to high rise residential development. Other than the two sub-city developments of Dwarka and Rohini the compact city policies of the DDA have largely lagged behind the actual developments. Policies have been more a reaction to development rather than guiding the development trend.

3.3 DENSITIES IN DELHI

Densities in Delhi increase with distance from the central area and continue to do so even at the urban fringes. The following table shows densities in different parts of urban Delhi.

Name of Area	Population, 1991	Area, 1991 (ha)	Density (pph)
National Capital Territory of Delhi - Urban	8,471,625	68,534	124
National Capital Territory of Delhi - Rural	949,019	79,766	12
National Capital Territory of Delhi - Total	9,420,644	148,300	64
New Delhi Municipal Council	301,297	4,274	71
Delhi Cantonment	94,393	4,297	22
Delhi Municipal Corporation	7,206,704	43,109	167

[Table 3.1] Table showing gross densities in urban Delhi, 1991
Source: GNCTD

The difference in densities is directly related to the urban fabric and development controls in each of the areas. High densities are also to be found on the periphery of urban Delhi. Although only low rise development was initially permitted in these areas, over time people violated the building by-laws in order to accommodate more and more people on the same land area. Today these areas are characterized by intense development.

3.4 EMERGING DENSITY PATTERNS

The density pattern of Delhi emerged as a result of the interplay of planning policies and various other political, social and economic factors. These are described below:

- **Planned Low Rise Imperial Developments**

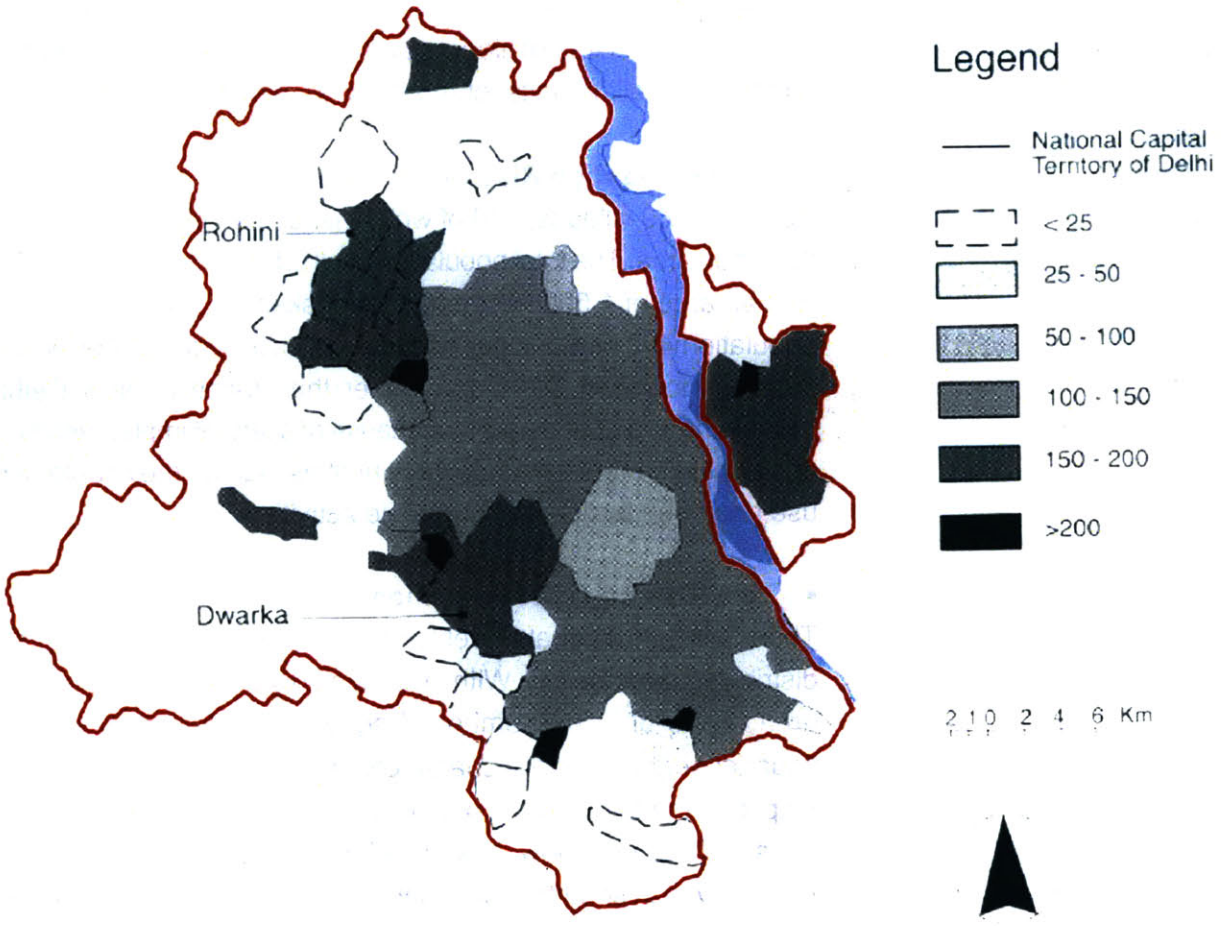
The lowest population densities and low intensity residential developments can be found in Lutyens' New Delhi, Delhi Development Authority areas in southern Delhi, and in Model Town in the eastern parts of Delhi. The Imperial town planning movement which gave birth to New Delhi, Model Town and Civil Lines advocated low rise orderly development, with large plot sizes and single storey buildings, with a maximum ground coverage of as little as 25% of the entire plot area. Lutyens' Delhi is located adjacent to the low rise planned commercial center of Connaught

Place. In complete contrast to theories that highly accessible areas are densely built and used primarily for commercial purposes, New Delhi is primarily residential, with some sectors having low rise commercial and office buildings.

- **Planned High Rise Developments**

Dwarka, Rohini and Narela in the south west and west of Delhi have been planned to accommodate higher gross densities. Since the late 1970's DDA has felt that Delhi has no more land to accommodate the exploding population, and maintains that densification can resolve the problem of scarcity of developed urban land. Dwarka is particularly important as it is planned to accommodate one million people on 5,645 hectares of land. DDA has decided that the private co-operative housing societies, various governments organizations, and the DDA itself will build housing in Dwarka in the form of high rise apartments. As much as half of the net residential area will be developed by co-operative

[Fig. 3.10] Gross densities in urban Delhi, 1991
Source: GNCTD



housing societies. Most co-operative housing is built as six to ten storeys. Plot development is meant to be negligible with only 38 hectares of land earmarked for residential plots. Private sector development in the neighboring states of Haryana and Uttar Pradesh have further reinforced the trend for increasing densities and high rise developments.

- **Illegal High Rise Developments**

The new phenomenon of illegal high rise developments on legally allotted plots has recently been observed. Private builders have generated a great demand for residential plots of between 165 and 420sq.mt. The model for such a development involves an agreement between the owner and the builder to intensify the development on a plot where low rise residential development already exists. Despite regulations limiting development to three and a half storeys high, or 12.5m, builders usually construct four or more floors. The deal is structured in a way in which the plot owner does not pay any money to the builder but the builder gets one floor in exchange for constructing three to four floors for the owner. This process of illegal apartment building has generated additional dwelling units for the growing middle class of Delhi.

- **Unplanned High Rise Urban Villages**

Delhi has 369 villages, 170 of which have been incorporated into the urban area. The total population of all urban villages is 600,000, with an area of 1,500 hectares. This makes the gross density of population 400 persons per hectare, which is closer to the higher densities found in Old Delhi, rather than those of New Delhi. Villages have higher densities because of a lack of implementation of planning controls. People have built as high as they could and use has been targeted at profitable activities.

- **Low Rise Squatter Settlements**

There are 1,100 squatter settlements in Delhi, which are evenly distributed over the city. With increasing distance from the central area of the city, the number of squatter clusters declines. All squatter settlements are characterized by low rise development. Inspite of the fact that the population has large household sizes, densities are quite low. It was estimated that a total 1,609,609 people lived in squatter settlements in 1997 on an area of 74,800 hectares giving a gross density of 22 persons per hectare.

- **High Rise Slums**

In 1989 the Delhi Municipal Corporation recognized 22 notified slums. They covered an area of 1,966 hectares and had a population of 1,800,000 giving a gross density of 900 persons per hectare, the highest anywhere in the city. These notified slums accommodated 21% of Delhi's total population.

- **Unplanned Development on Undeveloped Land**

As the city expanded rural areas were incorporated in the DMC area. Before the authorities could act farmers subdivided agricultural land into plots of varying sizes and sold them at cheap rates to poor people. Since no development work was undertaken to provide on-site services, the lower prices attracted those who could not could afford developed urban land. However, the process allowed for the provision of services at a later date when the development has already taken place. This process has proved a hindrance to the implementation of more compact development.

Over the years Delhi has grown in terms of both its geographical size and its population. Between 1951 and 1991, Delhi's area increased by more than three and half times while its population grew by eight times. As a result densities increased considerably. Urban Delhi's extremely low gross density of 73 persons per hectare in 1951 rose to 124 persons per hectare by 1991. While the city's area increased by more than three times between 1951 and 1991, the average trip length doubled between 1970 and 1993. This shows a direct relationship between the geographical area and the average trip length. Also as the geographical area has increased it has led to longer networks of infrastructure.

The decision to introduce the new metro rail has been influenced by Delhi's growing size, failing infrastructure and poor physical conditions. It is felt that the new mass transit system would have a positive impact in addressing some of the issues mentioned above. However, examples of other cities have demonstrated in the past that just the introduction of mass transit may not resolve any of the problems that currently plague Delhi, but if this infrastructure intervention is coupled with an efficient planning structure then it could have a tremendous impact on not just the physical condition of the city but also its form and geographical size.

Notes

[1] Mehra, S., *Outlook*, Delhi. 1999

[2] King, A., *Colonial Urban Development, Culture, Social Power and Environment*, London: Routledge and Kegan Paul. 1976

[3] Visaria, P., *Urbanization in India: an overview, in Urbanization in Large Developing Countries, China, Indonesia, Brazil and India*, Oxford: Clarendon Press. 1997

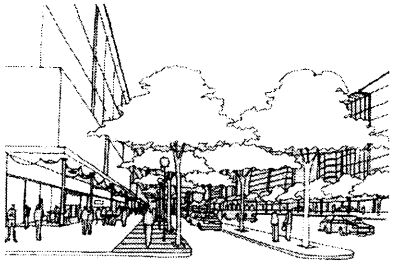
[4] United Nations, *Population Growth and Policies in Mega Cities, Paper No. 6*, New York: Department of International Economic and Social Affairs, United Nations. 1986

[5] Kumar, A., *Does the master plan for Delhi have a coherent policy framework?*, Delhi: Urban India. 1996

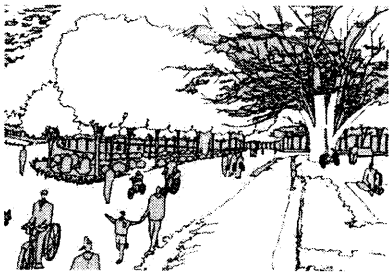
04
CITY VISIONS

Advent of the new metro rail is seen as an opportunity for the city to introduce new development patterns in the existing fabric and to form an overall urban framework within which future restructuring and urbanization can takes place. Accompanying financial investment and the image transformation of individual areas would further help in the restructuring process.

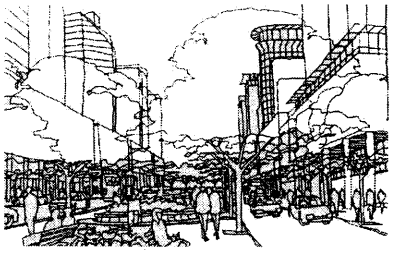
For Delhi to take advantage of the new transit system and for it to address its future needs it should be restructured along the following visions:



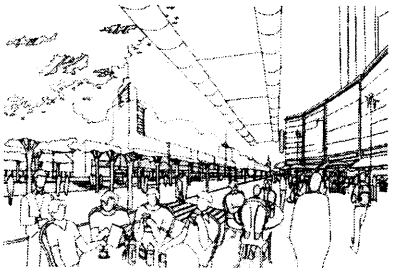
- Delhi as a **"Livable City"**[1]
  - Infrastructure provision and its coordination with development
  - Environmental concerns – air, noise, chemical pollution
  - Travel pattern and time



- Delhi as a **"Sustainable City"**[2]
  - Sprawl and growth of the city
  - Urbanization of rural agricultural land
  - Ecological concerns
  - Diminishing size of the green belt
  - More participation by citizens in development decisions for the city



- Delhi as an **"Equitable City"**[3]
  - Job housing balance
  - Mixing of housing typologies
  - Provision of social infrastructure
  - Provision of open space
  - Provision of physical infrastructure



- Delhi as an **"Ordered City"**[4]
  - For the city to read as one yet maintain identities of individual parts
  - Aesthetics in the city
  - Conservation of cultural heritage
  - National capital identity and the spirit of democracy

[Fig. 4.1] City Visions
Source: BMPA

The following categorization shows the relationship between the perceived visions and the impact they might have on the city.

Vision	Elements of the Vision	Impact on the City
A city that provides for all physical needs	Housing and employment. Education and training. Transportation infrastructure. Access to service and facilities.	Physical conditions: Some form of containment of development to stem or even reverse sprawl and preserve the countryside; this can be aided through the reuse of underused and disused derelict and contaminated land to make it productive again, help make the city more compact and, by doing so to a tolerable degree, avoid unnecessary development of greenfield sites. A reasonably high population density to achieve viable local service and facilities that is a high level of activities and interactions and thus vibrant settlements and places, and viable public transport. A mixed use environment, specifically a higher concentration around public transport nodes in walking and cycling distance from people's front doors, in order to increase access to services and facilities and thus generate a vibrant environment, maybe even a sense of community, and to reduce to some degree the need to travel. Adaptability to changing socio-economic conditions so that the city can change, expand and contract without much upheaval. Provisions that the city can make: Public transport in order to increase access to services and facilities, help reduce car dependency and thus congestion and pollution, achieve a reduction of energy consumption and help maintain a high level of energy-efficient and environment-friendly mobility inside the city and between two cities. Reduce traffic volumes and disperse vehicular transport, as a result of the availability of public

		transport and the design of road profiles, to avoid congestion of roads and urban areas. A hierarchy of services and facilities of different capacity and scale, from local provision in close proximity to one's front door to city center provisions; this, together with a high degree of mobility will increase choice. Access to green open spaces, the city's green lungs, for recreation and sports, natural reserves, forestry etc. .
A city that ensures safety, security and protection	A visually and functionally ordered and controlled environment. A city free of pollution and noise. A city free of accidents and crime.	Environment and ecological conditions: An environment free of pollution, noise, congestion, accidents and crime. Personal private outdoor space for each individual dwelling in form of gardens, roof gardens, terraces etc. A symbiotic relationship of the city with the country through inclusion of open space linking directly with nature; the spaces to be used for forestation, farming, large scale industries, sports and recreation to make the city self sufficient to as high a degree as possible.
A conducive social environment A good image, reputation and prestige for the city	A city where people feel a sense of community and belonging. A city that provides a sense of confidence and strength. A city that provides opportunities for individuals to shape their personal space.	Socio-economic conditions: Social mix to reduce or eliminate social and locational stratification, achievable through higher population densities and a wide range of dwelling and tenure types. A degree of local autonomy, the ability of individuals and the communities to shape their own environment according to their needs and aspirations; this would also support if not generate a sense of place and community, a sense of belonging.

A chance to be creative for its citizens	Opportunity for communities to shape their own districts and neighborhoods.	A degree of self sufficiency, with different degrees of intensity, in terms of employment, energy, water, goods; the city not only as consumer but a producer of goods.
A city that forms an aesthetically pleasing environment	A city that is well designed and can adapt to change in the future.	Visual-formal quality: Imageability of the city as an entity and of the parts of the city, the neighborhoods and districts.
	A place that is physically imageable.	Provision of a sense of centrality and place.
	A city that conserves and enhances its culture.	

Notes

[1] "Livability" is perceived as a measure of infrastructure provision and the environment created in the city.

[2] "Sustainability" is defined by the physical form of the city, its urban sprawl and rural-urban land ratio.

[3] "Equity" is perceived as social equity in respect to access to infrastructure, open spaces, employment centers and housing.

[4] "An ordered city" refers to a visual order for the city, a sense of order that maintains the character of individual parts but yet generates an identity for the city as a whole.

05

DELHI: MICRO SCALE URBAN INTERVENTIONS

5.1 THE CHANGING NATURE OF URBAN PLANNING

The nature of urban planning is undergoing a transformation world over. A study of different city regions (Singapore, Bangkok, Mexico City and New Bombay) results in the following conclusions with respect to the changing nature of urban planning:

- Planning which seeks to influence in detail the location and form of all regional development seems increasingly irrelevant and unachievable.
- Various ideas that have been employed in the past to limit the growth of the city like green belts and new town developments have shown their failure in doing so and are unsustainable in nature for most city regions being planned today.
- The idea of managing the overall inventory of land for development, and tightly programming infrastructure development to control the timing of development is in most cities not a practical possibility.
- With new technologies being used for communication, a lot of businesses that conventionally needed to be in the central business district are today free to establish in different parts of the city. Hence there is more scope of private development decisions and the intervention of the government can be limited in nature. The changing nature of the central business district would have an effect on the overall density of the center city and with better accessibility could lead to new patterns of development at the urban fringe.

The above observations encourage one to think for a new role for planners to shape the city region. New forms of intervention are required which unlike the practice in the past (which focused on region wide issues) would focus on detailed planning and coordination necessary in critical development areas. These areas may include already planned developments in the city center which require infill development, areas emerging as new subcenters at the fringe of the city, waterfronts, low income group areas requiring redevelopment or upgradation, land banks in the city center for high density development and areas close to major infrastructure like airports.

The role of the planners would be to assure that the detailed structure of such areas accommodates human needs, efficiently uses public infrastructure and has a development pattern that is

sustainable in the long term. Hence planners would focus on concentrated efforts like the sites mentioned earlier and in time the regional form would be structured around many such limited interventions.

The reasons behind the failure of Delhi's planning are no different than those mentioned above. The issues and challenges faced by the city and its planners are the same. In this chapter an attempt has been made to structure development scenarios for four different prototypical areas in the city of Delhi that will be impacted by the advent of the new mass transit system.

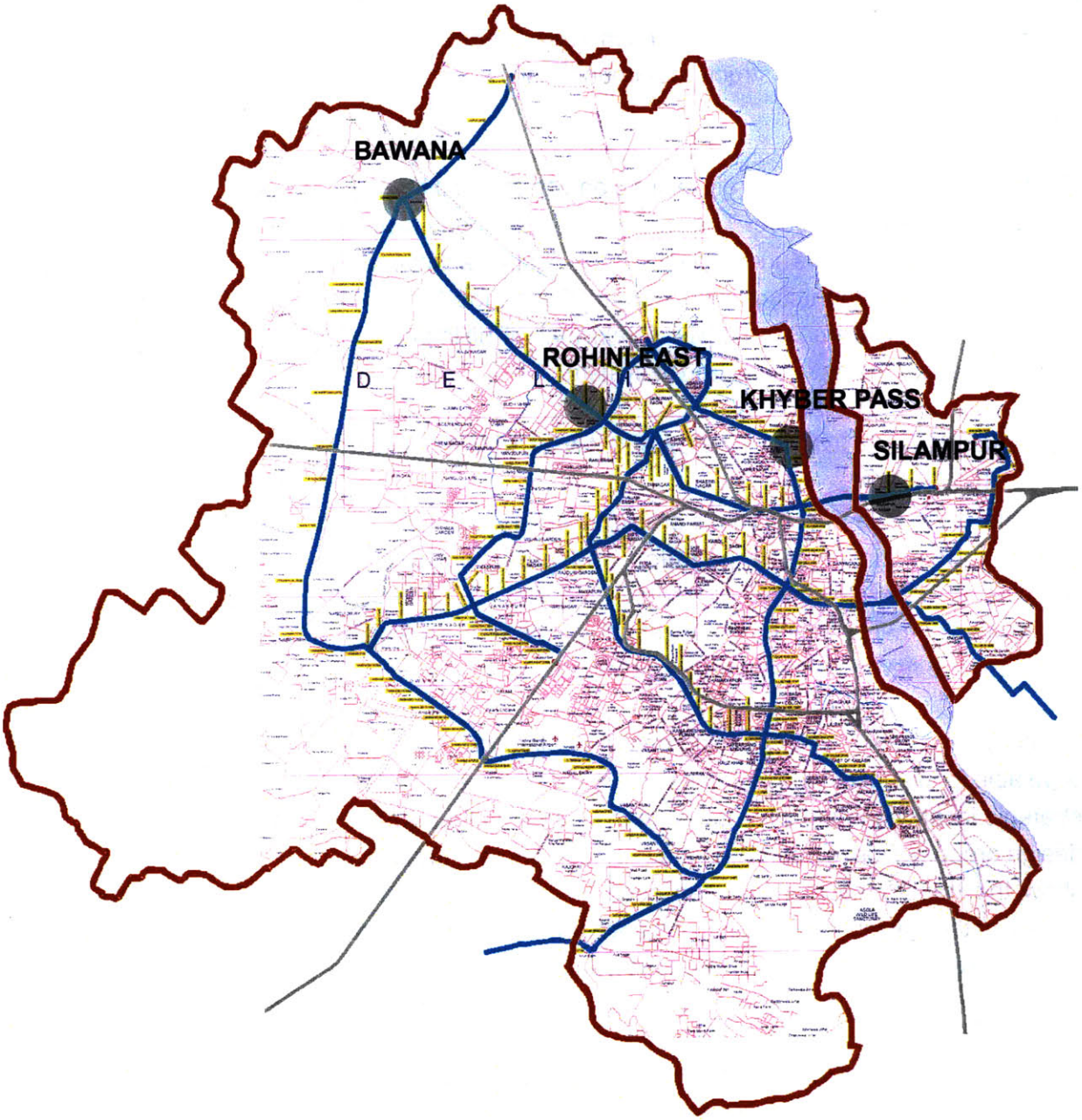
5.2 INTRODUCTION TO THE CASES AND CRITERIA FOR SELECTION

For Delhi to be able to confront its problems of migration, traffic congestion, environmental pollution and urban sprawl, a coordinated effort is required to improve mobility, concentrate urban development, balance the location of jobs and housing, and introduce new controls on urban development.

As mentioned earlier, the changing nature of planning makes it advisable for planners today to make small scale interventions at strategic locations in the city. It is with this intention that urban design proposals have been illustrated for four different areas to show the transformations that can occur in the development pattern of the city fabric as a result of the advent of the new metro rail. The selection of the study areas is done to show different development conditions with respect to the following factors:

- Location in the city – center or periphery.
- Number of similar nodes or development conditions that can be identified within the completed mass transit system.
- Built to non-built relationship in the surrounding fabric.
- Potential for transformation in the area – infill, upgradation, new development at the periphery or high density urban development on new land banks.
- Planned or unplanned existing development.

Each of the proposals examines an area of approximately 300 Ha or three square kilometers[1] around the selected station nodes. In some cases the area being studied varies depending upon the context and nature of development being proposed. Factors that



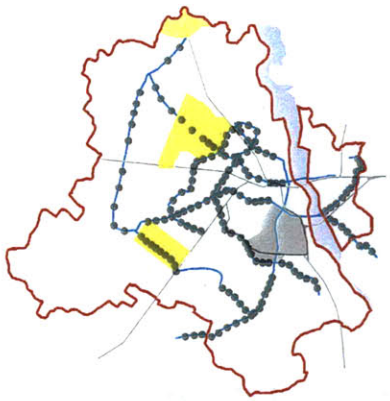
[Fig. 5.1] Location of the four prototype areas in Delhi
Source: RITES

were considered in forming the different development scenarios included:

- Development goals at the micro scale and their relationship with the overall visions for the city.
- Population density.
- Land use in the area and development capacity.
- Nature of existing development.
- Public or private development.
- Development guidelines.

The four areas that have been identified for the study are:

- **Rohini East**, is part of a planned development by the Delhi Development Authority.
- **Silampur**, is a low income resettlement colony which was initially a planned development but over the years the stock of informal housing and squatter settlements has increased.
- **Khyber Pass**, is a land bank owned by the Delhi Metro Rail Corporation which has become available to the city due to the accessibility provided by the new transit line.
- **Bawana**, is a prototype for a new high density mixed use development. It is located in a potential growth center as identified by the National Capital Region Plan[2] at the present urban fringe.



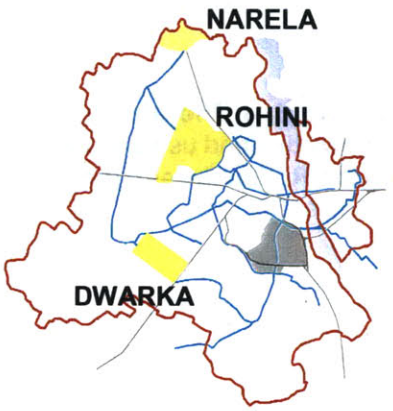
[Fig. 5.2] Plan showing areas in the city which have characteristics similar to the Rohini Development
Source: Author

5.3 ROHINI EAST: INFILL DEVELOPMENT IN A PLANNED URBAN AREA

Rohini was planned by the Delhi Development Authority in the 1980's and was widely considered to be a landmark in urban planning for the development authority. It was part of the Master Plan strategy to create 'mega projects' aimed at developing new peripheral zones of the city leading to the creation of satellite townships. Rohini, Dwarka and Narela are all such mega projects forming an extension to the main city.

5.3.1 EXISTING AREA CHARACTERISTICS

The project was planned by the Delhi Development Authority for a population of 850,000 (170,000 households) on 2,500 Ha[3] of land in the north-west zone of Delhi. It formed an extension to the urbanized land in Delhi at the time and was taken up so as to fulfill the housing backlog and to accommodate the growing population.



[Fig. 5.3] Mega projects of the Delhi Development Authority
Source: Author

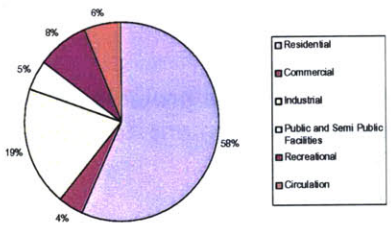
Out of the three projects Rohini was the first development to be planned . The metro rail would connect it to areas at the fringe.

It was envisaged that the project would be self-financing in nature and have a repeatable strategy by means of cross-subsidy so as to lower the cost of housing. This would help target the affordable range of various income groups – especially the economically weaker section and lower income group population. The project was initially planned in three phases and currently a further extension to the project is being considered. Other than the residential component of the project, it provides for adequate social facilities for the targeted population, employment for 300,000

workers[4], major facilities of health, education, social, cultural and large recreational areas in addition to playgrounds at neighborhood level. Intensive utilization of land has been achieved, resulting in a compact development to conserve land and energy resources, without compromising on the level of infrastructure provided. The land use distribution for the project is described in the table below:

Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Residential	1413.00	56.52	1.66
Commercial	110.00	4.40	0.12
Industrial	485.00	19.40	0.57
Public and Semi Public Facilities	126.00	5.04	0.14
Recreational	211.00	8.44	0.24
Circulation	155.00	6.20	0.18

[Table 5.1] The above table shows the land use distribution in the Rohini development
Source: DDA



[Fig. 5.4] Land use distribution in Rohini
Source: DDA

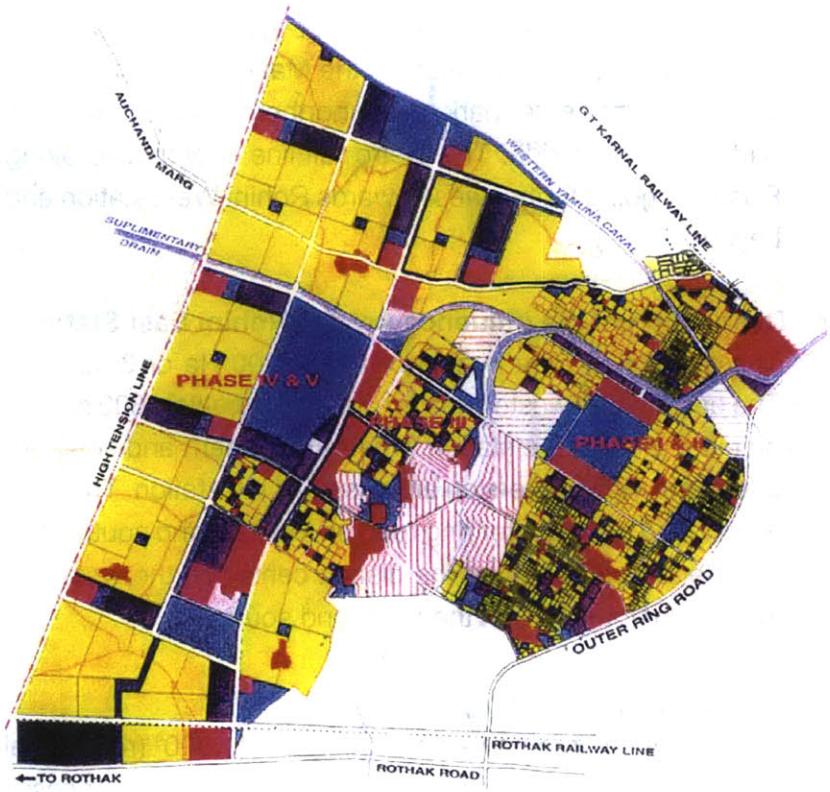
■ Planning Strategy and Urban Fabric

The Rohini project was proposed as part of DDA's initiative for extending the urban limit of Delhi and to accommodate the growing demand for housing. Rohini provides housing for a composite society consisting of all income groups. Due to the low housing affordability of a significant number of households, large numbers of plots have been provided with basic shelter and services so as to reduce the initial investment required by the household. Over a period of time individual owners can incrementally improve and add to their shelter according to their needs and financial means. To achieve a social balance in the development, the layout of the residential areas has been planned predominantly to cater to the needs of economically weaker section and low-income groups of people. Housing consists of plotted development, group housing and by DDA under its various schemes.

The gross residential area has been planned in multiples of a module called a sector. The project is divided into a total of 25 sectors. Each sector is to be self-contained in terms of essential facilities and amenities. Peripheral roads provide public transport routes that are within walking distance from any part of the sector. Facilities and amenities are provided either in a linear form or in the form of a nucleus. The sector layout is designed to optimize the infrastructure network and to ensure equal accessibility to all facilities[5]. The structure of a typical sector and neighborhood is described below:

- **Sector Structure**
  - Area per sector: 100 Ha or 1 sq.km.
  - Population per sector: 60,000 (Residential: 40,000 and Employment: 20,000)
  - Density (Gross): 600 pph
  - Density (Residential): 400 pph
  - Employment: 20,000 people
  - Industry: Trade, commerce, service industry and others

  (Source: DDA Project Report on Rohini Development)



[Fig. 5.5] Rohini Land Use Plan as proposed by the DDA
Source: DDA

Currently phase 1,2 and 3 are built and the planning for phase 4 and 5 is ongoing.

- **Neighborhood Structure**
  - Area per neighborhood: 25 Ha
  - Population per neighborhood: 15,000
  - Population density: 600 pph
  - Four neighborhoods form one sector

  (Source: DDA Project Report on Rohini Development)

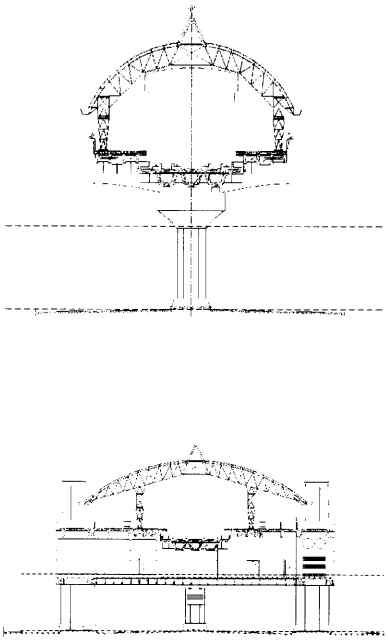
The average gross density proposed to be achieved is 600 persons per hectare (pph)[6]. A typical residential sector provides for plots of sizes varying from 26 sq.mt. to 120 sq.mt[7], with a provision of four storeyed group housing.

Local shopping requirements are met by providing built up shops as well as platform shops. Open spaces have been provided as parks, playgrounds and cluster level open spaces. Local shopping centers and other community facilities are grouped all along the system of continuous open spaces or in a form of a nucleus.

5.3.2 PROPOSED INFILL DEVELOPMENT PLAN FOR THE DELINEATED AREA AROUND ROHINI EAST STATION

- **Description of the Delineated Area**
- **Location of the Station**

  The Rohini East station is the first station in the Rohini development and is elevated on the Master Plan Road 41. It abuts a sports center park on the northern side and Road 41 on the southern side. The metro rail line is proposed along Road 41, going further west towards Rohini West station and beyond.



[Fig. 5.6] Sections of the mass transit station at Rohini East
Source: DMRC

The mass transit line at the Rohini East Station is elevated and the stations proposed is of a modular plug in type.

- **Delineation of the Influence Area of Rohini East Station**

  The delineated area is approximately 300 Ha or 3 sq. km[8]. The eastern and western edges are approximately 600 meters on either side of the station, whereas northern and southern edges are 1250 meters on either side of the station. The area is bounded by the outer ring road on the east and south-east, an arterial road abutting the district center on the west and internal major roads on the north and south.

- **Population and Density**

  The influence area had a population of 141,000[9] (residential population) in the year 2002. Thus the gross residential density

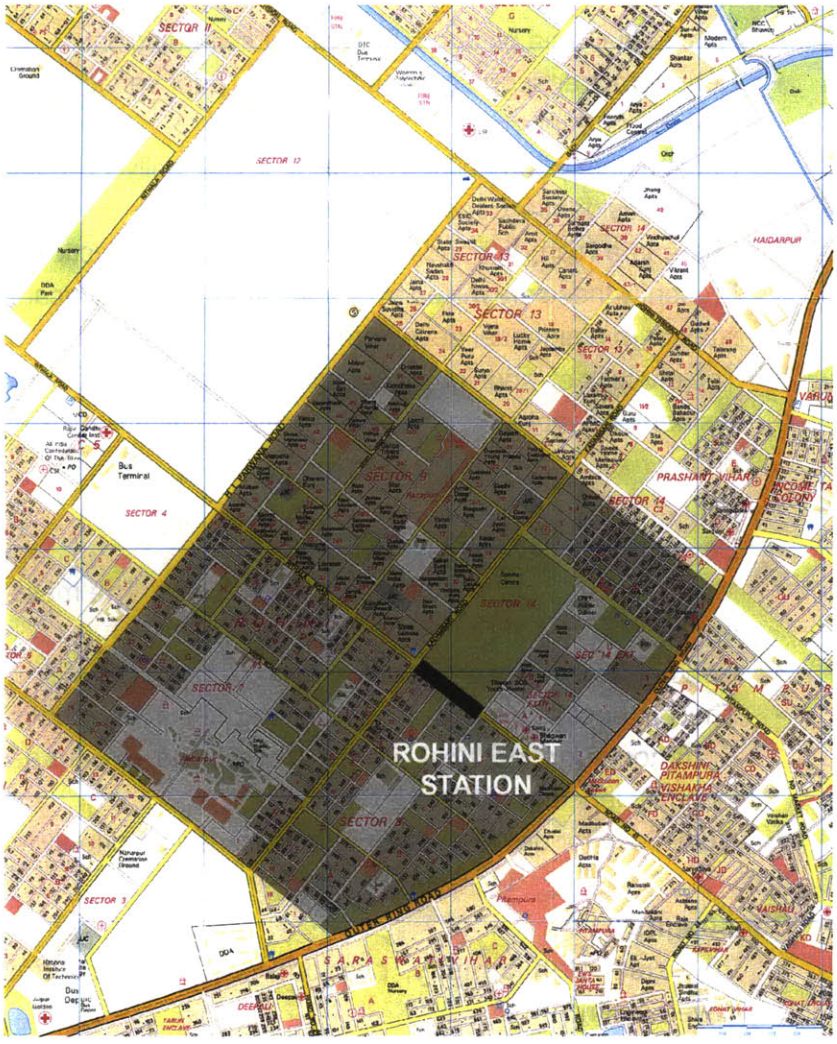
was 470 people per hectare. The number of people employed in the area is 23,000[10] and the influence area is spread over five sectors.

- **Land Use**
  - Planned as mono use, residential area with segregated and exclusive land use pattern[11].
  - No mixed land uses were planned for.

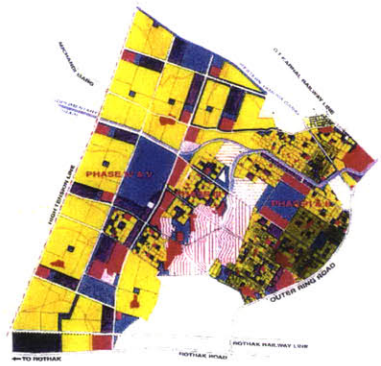
- **Built Form**
  - Low rise, high density.
  - Characterized by plotted development (up to 15m) and by group housing development (up to 26m)[12].

[Fig. 5.8] Typical plotted development in the area
Source: Author

[Fig. 5.9] Typical group housing development in the area
Source: Author



[Fig. 5.7] Rohini East Station Node in context with the delineated area (marked as shaded)
Source: Eicher City Map



[Fig. 5.10] Land use plan of Rohini showing the study area
Source: DDA

- **Amenities**

  The area has numerous community centers and a sports center.

- **Projected Passenger Load for Rohini East Station in 2021**

  The Delhi Metro Authority estimates that the Rohini East Station will be handling 245,000 people by the year 2021[13].

- **Time Taken to Walk to Peripheral Transport**

  Approximately six to eight minutes average walking time is required to walk to the periphery of the development.

Design Considerations

- **Issues**
  - Residential area planned, but not yet self-sufficient.
  - Peripheral transport services fail due to poor service and clogged arterial roads.
  - Approximately 300,000 people move in / out daily for work.
  - A high residential density of 600 pph[14].
  - There is a high demand for retail commercial functions. Presently these are mixed by 'substitution' in either vacant sites or in residential developments.
  - The process of 'addition' of commercial activities and new residential development in existing residential buildings is on the rise.
  - Influx of informal sector.
  - Development of district center is slow.
  - Most residents cannot afford private vehicles. The mass transit can offer appropriate public transport.
  - Road network is incomplete.
  - The distances to work are large and since the public transportation network is not developed it causes inconvenience to the residents.
  - Guidelines for development must be issued on priority.

- **Constraints**
  - Low rise high density, predominantly residential development.
  - In the initial plan for the area roads had been optimized for pedestrian traffic, with the idea of integrating public transport at the periphery. But presently there is a lot of

vehicular traffic on internal roads, thus making it difficult to reach the periphery.

- Mixed use development has encroached upon the roads.
- Planned facilities like district centers and community centers have not been completed, leading to organic growth because of the pressures of development.
- One observes a total substitution of land uses along Road 41 and this caters to the demand of the local population and passing traffic.
- Segregated mono land use plan with no provision for mixed or multi use development.
- Planned surface parking is inadequate.

- **Potentials**
  - High density of 600 pph (residential) is conducive for transit oriented development.
  - Providing better public transportation on the periphery to encourage pedestrian movement in the internal areas.
  - The area has some space for infill development which can help increase density near the station.
  - The Rohini East node will become significant with time, as future urban extension projects have been proposed for Delhi in the north-west zone.
  - A district center of 100 Ha is near to the station and can be well integrated in the development plan for the area.
  - The station abuts an open park and sports complex.

■ Elements of the Study Area

The study area covers 300 Ha of the Rohini development. Road 41 and Outer Ring Road are the two important roads in the area. On the south and west edge of the site there are two city level commercial centers. It is conceived that densification in the form of infill development, new floors as additions to existing structures and consolidation of plots will happen along these roads and around the transit station. Also improvements can be made to the design of Road 41 to accommodate some of the existing informal commercial activities that presently make traffic circulation slow and cause congestion. The area has some informal settlements and the development proposal considers these sites as opportunities for either an onsite upgradation programs or for new in-situ development proposals. Mixed use development has been

encouraged in the area with a view to increase residential land use and also to provide opportunities for setting up of home based non polluting industries. Overall the proposal makes an attempt to test the effect of increased accessibility on the redistribution of population and redensification in a planned development in the city.

■ Development Plan for the Primary Area

To devise a methodology to determine the nature and extent of infill development to be proposed in the study area, the delineated area has been divided into 30 sectors of 10 Ha each. For the same, existing population distributions and densities have been calculated. It is thought that with the coming of mass transit to the area the existing residential densities (470 pph) will increase to between 600 and 900 pph due to increased accessibility, redistribution and redensification, given that the size of the area remains the same. This will however depend on the absorptive capacity of each of the 30 sectors and type of buildings that exist there. The figures below show the redistribution proposed for the 30 sectors. The redistribution is based on the data from a primary survey conducted in the area and from observations made from a field trip to the site.

7500	4000	6750	6750	4500
7000	6750	6750	P	3500
7000	7500	7500	P	4000
4500	5500	4500	3500	3000
6500	2750	4500	3750	4000
3250	4500	4500	3750	3000

[Fig. 5.11] Existing Population Distribution for 141,000 people
Source: Author

750	400	675	675	450
700	675	675	P	350
700	750	750	P	400
450	550	450	350	300
650	275	450	375	400
325	450	450	375	300

[Fig. 5.12] ExistingPopulation Density 470 pph
Source: Author

9000	5750	8500	8500	6500
8500	8000	8500	P	5500
9000	9000	100-00	P	7000
7500	8500	9000	7500	6000
7500	6000	7000	6000	6000
4000	7000	7000	6000	4500

[Fig. 5.13] Proposed Population Distribution for 203,250 people
Source: Author

900	575	850	850	650
850	800	850	P	550
900	900	1000	P	700
750	850	900	750	600
750	600	700	600	600
400	700	700	600	450

[Fig. 5.14] Proposed Population Density
Proposed: 600-900; Achieved: 670 pph
Source: Author

■ Land Use and Development Character

The figures below show the land use split in the area with both the present land use and then with the proposed infill for both the present and projected population.

[Table 5.2] Before infill development for 141,000 population; Source: Author

Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Residential	135.00	45.00	0.95
Commercial	4.00	1.33	0.02
Industrial	0.00	0.00	0.00
Mixed Use	0.00	0.00	0.00
Public and Semi Public Facilities	12.50	4.16	0.08
Recreational	40.25	13.41	0.28
Circulation	60.00	20.00	0.42
Informal Housing	20.00	6.66	0.14
Vacant Sites	28.25	9.41	0.20
Government	0.00	0.00	0.00
Total	**300.00**		

[Table 5.3] Before infill development for 203,250 population; Source: Author

Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Residential	135.00	45.00	0.66
Commercial	4.00	1.33	0.01
Industrial	0.00	0.00	0.00
Mixed Use	0.00	0.00	0.00
Public and Semi Public Facilities	12.50	4.16	0.06
Recreational	40.25	13.41	0.19
Circulation	60.00	20.00	0.29
Informal Housing	20.00	6.66	0.09
Vacant Sites	28.25	9.41	0.13
Government	0.00	0.00	0.00
Total	**300.00**		

[Table 5.4] After infill development for 141,000 population; Source: Author

Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Residential	160.00	53.33	1.13
Commercial	5.50	1.83	0.03
Industrial	0.00	0.00	0.00
Mixed Use	10.50	3.50	0.07
Public and Semi Public Facilities	21.00	7.00	0.14
Recreational	40.25	13.41	0.28
Circulation	60.00	20.00	0.42
Informal Housing	0.00	0.00	0.00
Vacant Sites	0.00	0.00	0.00
Government	2.75	0.91	0.01
Total	**300.00**		

Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Residential	160.00	53.33	0.78
Commercial	5.50	1.83	0.02
Industrial	0.00	0.00	0.00
Mixed Use	10.50	3.50	0.05
Public and Semi Public Facilities	21.00	7.00	0.10
Recreational	40.25	13.41	0.19
Circulation	60.00	20.00	0.29
Informal Housing	0.00	0.00	0.00
Vacant Sites	0.00	0.00	0.00
Government	2.75	0.91	0.01
Total	**300.00**		

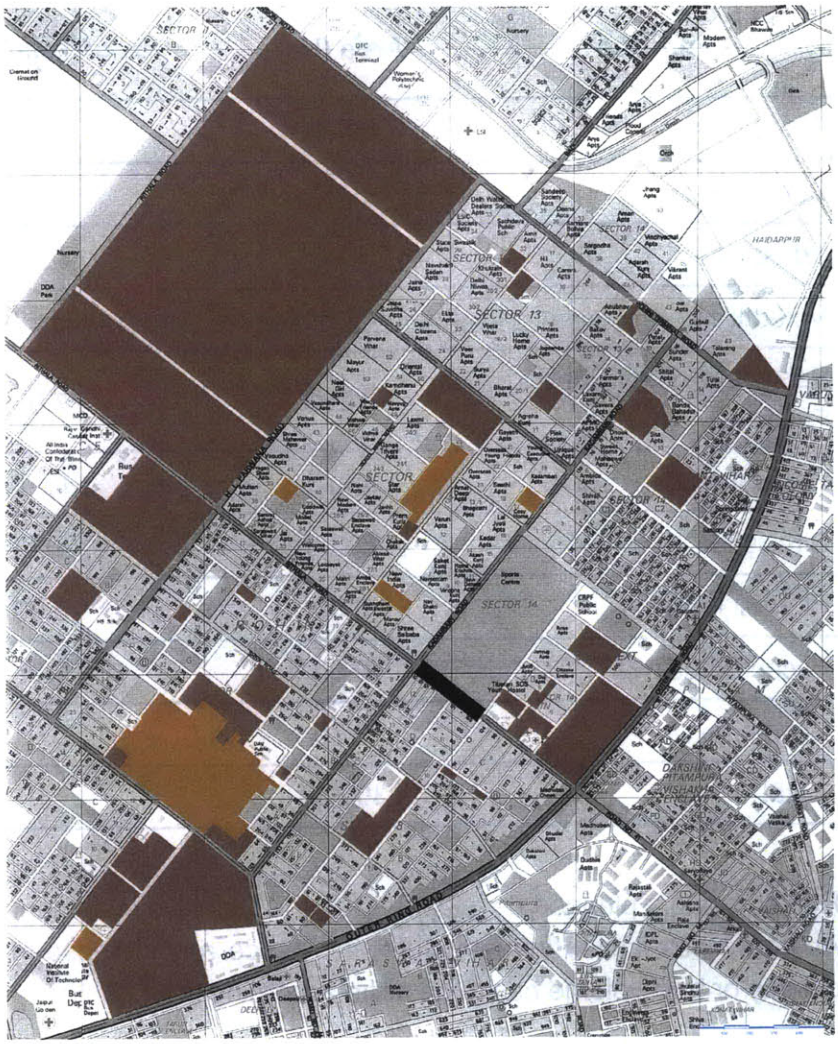
[Table 5.5] After infill development for 203,250 population
Source: Author

Rohini, being a planned development by the Delhi Development Authority, has limited infrastructure and hence any increase in density or built volume has to be done accordingly.

The projected increase in population is in accordance with the development capacity of the delineated area with respect to open space, infrastructure and public amenities.

It is conceived that with the advent of mass transit, an immediate transformation will be seen in the form of development of the two district centers which are towards the edge of the proposed site. They had been planned as per the first Master Plan in 1962 but till date remain undeveloped primarily due to the poor accessibility of Rohini with the remaining city.

In the delineated zone an emphasis will be first seen to develop sites which had been originally planned for (as per the original land use plan for the project) but have not yet developed. These include both community center sites and small scale commercial establishments.

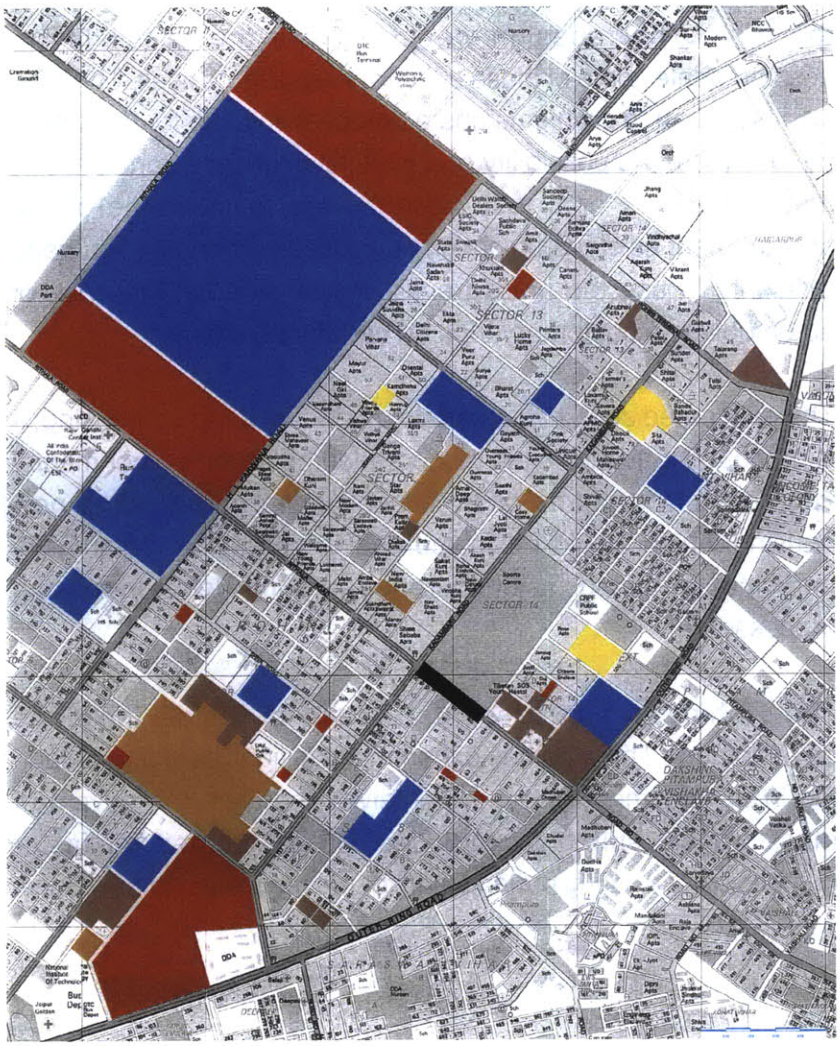


[Fig. 5.15] Phase 1 of the proposed intervention
Source: Eicher City Map

This phase would identify existing vacant sites and also squatter settlements in the area.

The next level of transformation will be seen in the development of vacant sites as per the infill development proposal. These sites are mainly residential or mixed use in nature. With time and due to market forces, the area along Road 41 will see consolidation of plots for development. It is proposed that to cater to the needs of the society better, and to keep a check on vested interests, the government should allow mixed use development on these sites.

This would encourage residential development along with non-polluting home based industries. An increase in density will also be seen as floors will be added to existing structures. To allow for such a change it is proposed that the government allows the construction of an additional floor onto existing structures. Most buildings in the area are low rise (3-4 floors) and can easily accommodate an additional floor. This would encourage both



[Fig. 5.16] Phase 2 of the proposed intervention
Source: Eicher City Map

This phase proposes the building of land uses that were originally planned but were not built due to lack of access to the area.

mixed use development (horizontally and vertically) and rental housing which would lead to an increased ridership for the transit system.

Vacant sites around the transit station would have more commercial functions and can be connected to the station by a system of sky walks. This could form an exclusive commercial zone. Such development would comprise of high-rise buildings and a higher FAR would be allowed by the government for such sites. This would help lend an identity to the new development and would encourage future real estate investment in the area.

The redesign of Road 41 is required to avoid the current traffic congestion that is caused on it due to the presence of informal commercial establishments that over time have encroached on

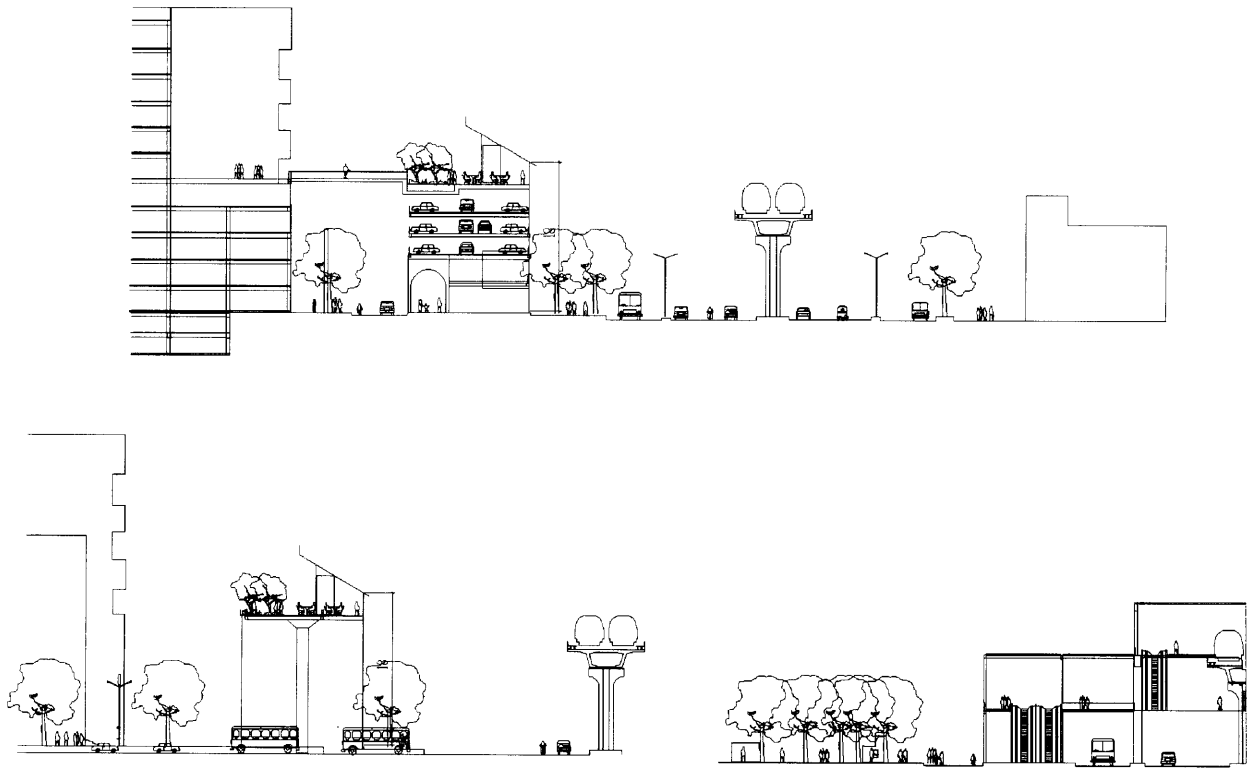
the road. The redesign would explore the possibility to accommodate some of these establishments there itself. The area also has parking problems and a potential solution for this would be to explore the possibility of a multi level underground parking below the park or to use vacant sites at the edge of the development as elevated parking structures. This will encourage residents to use the mass transit system and limit the use of automobiles to customary trips on certain days only.

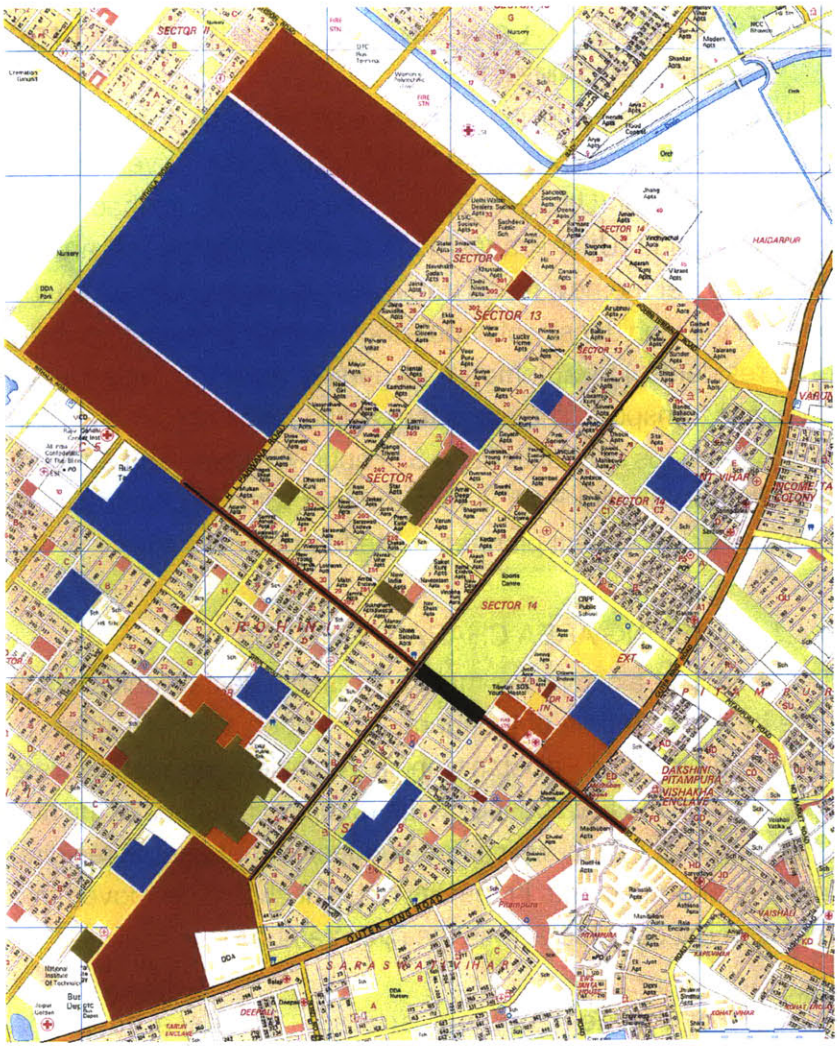
The delineated zone has a certain amount of informal housing; it is proposed that such sites be upgraded by either environmental upgradation programs or by consolidating and building new housing which would be mixed use in character. Community participation would be encouraged in such decision-making processes.

[Fig. 5.17] Proposed redesign of Road 41
Source: Author

With time due to market forces the area will see the amalgamation of plots around Road 41 leading to a more consolidated development pattern.

The Rohini project presents a case of inside the edge development. The area has experienced a significant percentage lag in development and it is perceived that with the advent of mass transit, suitable conditions will be created for faster completion of existing projects and for the realization of new ones.





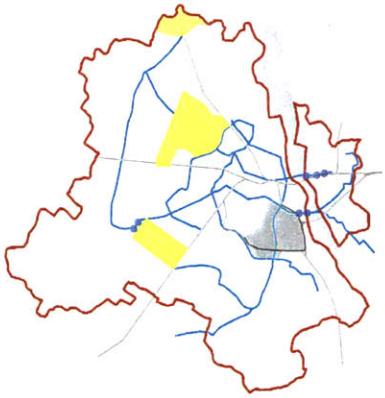
[Fig. 5.18] Final Infill Plan
Source: Eicher City Map

Shows the final plan for the area. Both existing and vacant sites have been built on. New development has also been proposed for area around Road 41 and along the Ring Road.

The mass transit system will help introduce new activity in the area which would capture the under committed development. Some of the undeveloped land is in strategic locations and this may be exploited for future transit oriented development.

There is also specific opportunity created for redevelopment in the form of strip development along Road 41 and in the redevelopment of squatter sites. Over time the area may see villas being replaced and amalgamated for housing and mixed-use development. The government should reconsider its development code to accommodate for such a change in the future.

There are over a hundred similar mass transit nodes in the city; a successful transformation of these can influence the character and absorptive capacity of the city.



[Fig. 5.19] Plan showing areas in the city which have characteristics similar to the Silampur Development
Source: Author

5.4 SILAMPUR: LOW INCOME AND SQUATTER REDEVELOPMENT

Silampur is located in the eastern part of Delhi. It falls under Planning Zone 'E' of the Master Plan. The area abuts river Yamuna in the west, Loni (Uttar Pradesh) in the north, Sahibabad in the east and Noida (Uttar Pradesh) in the south. It is the first area in the city to get the new mass transit line, a decision taken on the basis of the high density of population in the area, low affordability of its residents, low automobile ownership and high dependency on public transport. The mass transit line in the area is at grade and the stations of Shastri Park, Silampur, Welcome and Shahdra are along it. Shastri Park is also a depot with large amounts of property development planned in the future for the site.

5.4.1 EXISTING AREA CHARACTERISTICS

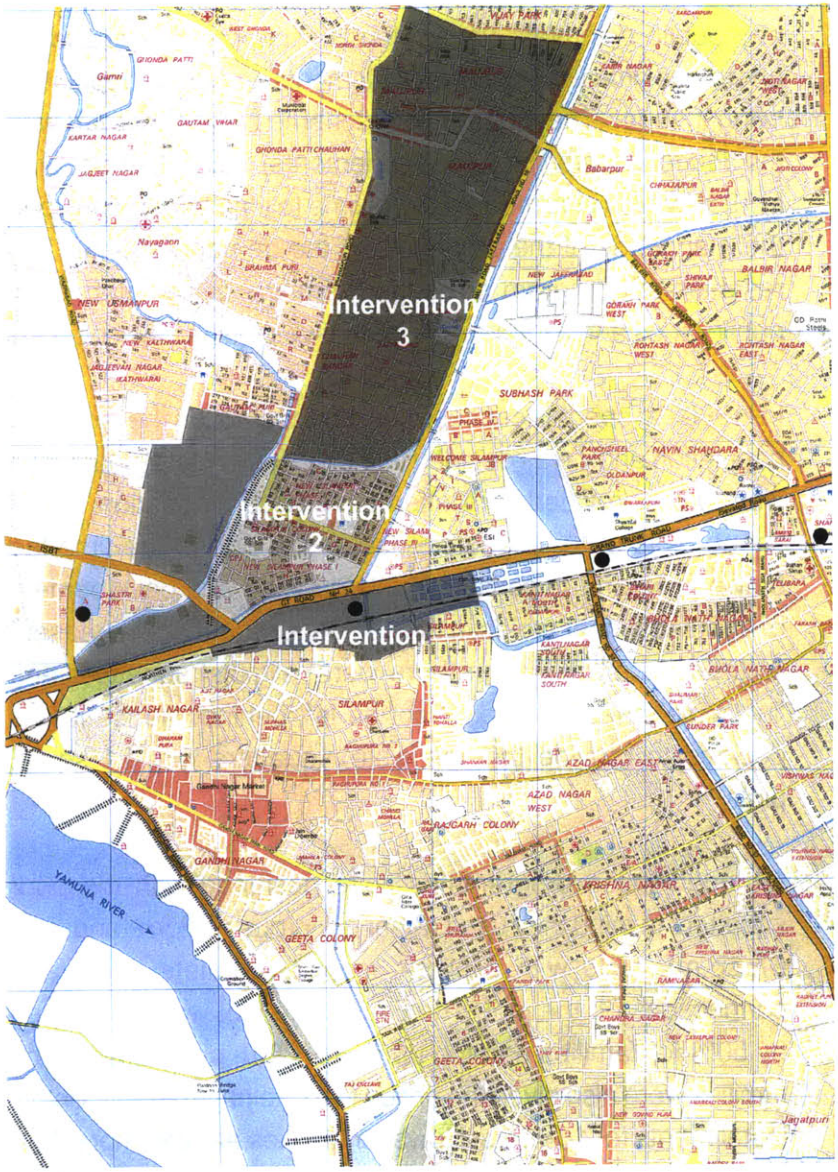
The overall area comprises mainly of resettlement colonies which date back to the time of independence, when land was given to people coming from Pakistan to India. Resettlement colonies were also made in the area based on the recommendations of the first Master Plan for Delhi which had suggested that people residing in squatter settlements in the city of Delhi should be moved into resettlement colonies across the river Yamuna.

As part of the development strategy for the area, three interventions are proposed:

[Fig. 5.20] Site Plan of East Delhi showing Silampur
Source: Eicher City Map

- **The first intervention** would be in the area along the mass transit line, which is at present either vacant or has low density development. Sites in this area can be consolidated and a new high density development be proposed on it. This would form a new development corridor, which will have a mix of commercial and residential land use. It will also provide sites for social infrastructure and open recreation spaces.

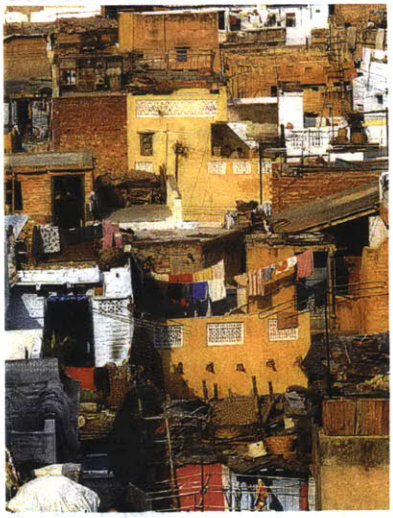
- **The second and third interventions** would be beyond the immediate core development in the already existing residential colonies. Most of these residential areas have poor amenities, no building regulation and lack basic infrastructure. It is proposed that such developments along with the squatter settlements in these colonies be upgraded. The nature of upgradation will depend on the existing condition of the colony.



[Fig. 5.21] Plan showing the three levels of proposed interventions
Source: Eicher City Map

[Fig. 5.22] Intervention Area 1
Source: Author

[Fig. 5.23] Intervention Area 2
Source: Author



[Fig. 5.24] Intervention Area 3
Source: Author

■ Characteristics of Resettlement Colonies

In order to propose any form of intervention in the area, it is critical to understand the city's resettlement policy and issues involved with the physical planning of such settlements.

▪ Delhi's Resettlement Policy: Origins and Subsequent Changes

In the first Master Plan of Delhi (1962-1981), a specific concern for low-income communities was expressed in the form of a resettlement policy. These communities were part of the constant flow of migrants to Delhi from the poverty stricken and economically deprived rural hinterland, who could not afford housing in the formal sector and hence squatted on

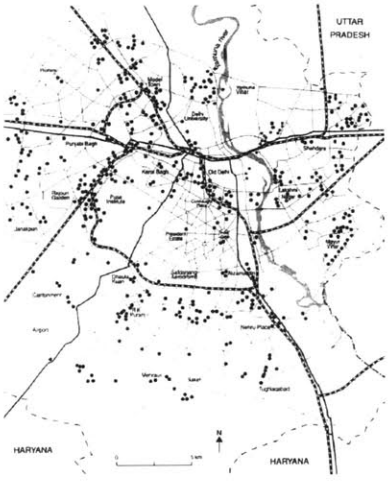
any public or private vacant lands. This process led to an enormous growth of squatter settlements and to the population living in them. The resettlement scheme in Delhi started with the *Jhuggi Jhompri* (squatter settlements) Relocation Scheme in 1960, which was modified from time to time depending upon the magnitude of the problem and the demand of time. The resettlement program envisaged removal of squatters from public lands and allotment of alternative plots in new colonies.

In 1960, a special census was conducted of the squatter population and it was decided that only the 'eligible' population was to be provided with alternative accommodation on 67 sq.mt. plots on a 99 years lease basis. Due to the time lag between when the census was conducted and development of new settlement projects, the number of squatters increased. At the time of relocation there were 'eligible' squatters and 'ineligible' ones who could not be left behind. Hence it was decided to provide the 'ineligible' squatters with 21 sq.mt. plots[15].

Although these programmes were designed with the poor squatters in mind they used rather generous design standards: 67 sq.mt. plots with a plinth, individual toilets and water connections on the plot. The cost of the plot was subsidized by 50% for families earning up to Rs. 250/- per month. Such families were also given the option to make payment in monthly installments for 10 years. However families earning more than Rs. 250/- per month were given plots on a no profit no loss basis by making full payment at the time of allotment. In addition, the beneficiaries were entitled to a Rs. 1000/- grant for the construction of the superstructure.

In 1962, the Delhi Development Authority (DDA) initiated the provision of modest built up tenements to squatters on rent. In 1964, as an alternate to those who could not afford to pay their installments for larger plots, it was decided to allot 21 sq.mt. plots on rental basis at a monthly rent of Rs. 12/-[16].

In 1967, the program of resettlement on 67 sq.mt. plots was put under review and it was felt that the plot size was too large and the general economic package was also considered



[Fig. 5.25] Plan showing all the squatter settlements in Delhi
Source: DDA

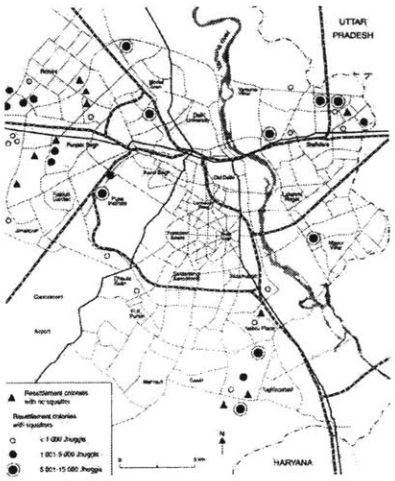
beyond the affordable limit of the target groups. As a result the scheme of 67 sq.mt. plots and built up tenements was abandoned and only 21 sq.mt. plots were to be developed[17].

In the late 1970's, DDA embarked upon the massive implementation of a squatter resettlement scheme. Land was divided into plots of 21 sq.mt. and provided with community toilets and drinking water facilities[18]. Allottees were not given a permanent title to the land but a right of occupation on payment of a monthly ground rent. However, as there was no administrative machinery to collect the rent and also for political reasons, the practice had been for families to reside free of cost.

In the 1980's, DDA provided for about 10,000 more plots in 'extensions' to resettlement colonies[19]. Under this scheme 10 sq.mt. built up rooms along with independent toilets and common stand post were provided to each squatter family. It was proposed to allot the transit camp on a rental basis. The allottees are allowed to construct the first floor. After the construction of about 1000 units the DDA took another ad-hoc decision to discontinue the scheme and to start a new 'sites and services' scheme under which 10 sq.mt. plots were to be provided to squatter families on a rental basis and the allottees will be allowed to erect their own informal structures. The plots were to be located near existing resettlement colonies and no community facilities were to be provided with the idea that the occupants will use the already existing community facilities of the resettlement colony.

A few years ago, DDA took the initiative to give ownership rights to the allottees in the earlier resettlement colonies on perpetual lease basis. To date there has been no response from the occupants on this issue.

Past experience shows that taking ad-hoc decisions of resettling large sections of the population with large subsidy has not proved to be financially viable. Nevertheless, resettlement is proposed to be continued, though as part of a strategy that would include building new structures, onsite upgradation and environmental improvement schemes.



[Fig. 5.26] Plan showing all the resettlement colonies in Delhi
Source: DDA

- **Physical Planning and Infrastructure Provision in Resettlement Colonies**

  In the years between 1960 and 1975, some 57,000 families were relocated in 18 new colonies. During the period of Internal Emergency (1975-1977), at least 141,820 housing units were demolished and around 700,000 evicted squatters were accommodated in 16 new resettlement colonies in less than a year[20].

  The planning of the colonies during emergency was done in a short period of time. The first projects were planned without much consideration except for the speed of execution. There was no regular planning grid, only varying lengths of back-to-back blocks were used to fill the available space.

  When the number of resettlement projects increased, a replicable planning module was evolved. A typical block with 500 plots and related services was developed. This typical housing block with slight variations was adopted in large projects.

  The typical block consists of 500 plots arranged in six rows of back-to-back plots with a central open space created by interrupting the middle two rows. Other minor open spaces were formed by removing chunks of five plots from each row of housing. The width of the streets inside the block was 5 meters where as outer peripheral street were 9 meters.

  Land use was classified as 30% for streets and roads, 30% for community facilities (schools, open spaces, commercial sites) and 40% for residential land use.

  The construction of ground and first floors was allowed, the permissible plot coverage being 100% for the ground floor and 80% for the first floor.

  Infrastructure standards were as follows: public toilets (one toilet for seven families), no bathrooms, one hand pump for 22 families for water, electricity in the form of street lighting and open storm water drains in front of the plots. The provision of infrastructure has been gradual and varies from site to site.

- **Transformations in Resettlement Colonies**

  Over the years resettlement colonies have transformed significantly. The typical transformations fall under three broad areas:

  - **Transformation relating to the contextual setting in the city**

  Initially resettlement colonies were essentially peripheral neighborhoods sometimes even lying outside the urban limits. With the growth of the city, most of these settlements can no longer be thought as peripheral, having been absorbed into the fabric of the city. The Silampur area is well connected to the rest of the city due to the linkage provided by the Grand Trunk Road and the new mass transit line. Economically also the Silampur colony, like most other resettlement colonies has transformed over the years. Today it has a high incidence of home-based economic activities which is linked to the nearby industries. Over the years the linkages between the work centers and the resettlement colonies have become stronger.

  - **Transformation relating to the original provisions within the colonies**

  Within the colonies the original provisions have substantially changed in both configuration (of plots, built form etc.) and use (of dwelling units, infrastructure, open spaces etc.). These transformations pertain to changes in land use (especially the invasion of residential land use by commercial and industrial activities), built form consolidation (often to an extent that apparently exceeds requirements arising out of purely use-value related compulsions).

  Amalgamation and sub-division of plots, upgradation of physical infrastructure by the authorities, stressing of infrastructure due to densification, mis-use and dis-use of provided open spaces and the emergence of squatters.

  Land Use

  Extensive commercialization on the ground floor along all vehicular roads is a common feature. The shops range from small petty shops to fairly large eating joints, specialized shops for clothes, shoes etc. In the case of 21 sq.mt. plots the entire

ground floor is used commercial activity whereas in the case of 67 sq.mt. plots there are generally shops fronting the road with residences at the rear.

Built Form

With the improvement in economic linkages with work centers and with other surrounding areas, the settlements have become to demonstrate fair levels of consolidation. The level of construction quality has improved over the years. Along the main roads one finds single to three storey structures. In colonies with 21 sq.mt. plots, the built form is intensive along the main roads, becoming less so within the blocks.

Plot Configurations

Amalgamation of two to four plots is quite common in areas with 21 sq.mt. plots, whereas both amalgamation and subdivision of plots is common in areas with 67 sq.mt. plots. Along the main roads, such plot amalgamations is more common which results in a higher level of non-residential use at the ground floor and better residential use at the upper floors.

Physical Infrastructure

The initial provision of basic infrastructure was on a community basis. Residents had public stand posts for water. Presently individual water connections have been extended to all colonies, each plot having one water connection. This has improved the quality of life in these settlements but with the emergence of rental housing and squatters within these areas, the residential densities have doubled and hence making water supply provisions inadequate. Likewise the community toilets provided, have become insufficient.

Social Infrastructure

Education facilities and community hall were, by and large, provided as planned. But medical facilities are available only at the initiative of private doctors.

Open Spaces

Open spaces in most colonies suffer from lack of maintenance and hence are either misused or disused.

Activity Spaces

In all these colonies, the 3m to 5m wide brick paved pedestrian paths are the most intensively used spaces. They are used by people from all age groups for various activities of active and passive recreation, as extensions of living spaces. The weekly market is usually held on these streets.

- **Transformations related to the resident community**

  The residents in these settlements have undergone socio-economic transformations or have changed. These transformations pertain primarily to the improving socio-economic circumstances of the residents, the emergence of rental housing markets in the settlements, up trends in the local housing market and the induction of new residents, on one hand, of higher income classes and on the other, of squatters.

[Fig. 5.27] View of the proposed site for first level intervention
Source: Author

5.4.2 PROPOSED DEVELOPMENT PLAN FOR THE FIRST INTERVENTION

The chosen area for the project lies along the new mass transit line, around the Silampur station. A linear site has been chosen as a result of limitation of space due to the already dense built fabric of the area. The surroundings form one of the most densely developed areas in the city of Delhi. Neighboring areas have predominantly low income group housing, squatter settlements and home based informal industrial units.

[Fig. 5.28] Edge condition between proposed site and existing development
Source: Author

- **Description of the Proposed Site**

The proposed site is accessed by the Grand Trunk Road (National Highway 24). The highway is an important link as it connects the main city of Delhi to the study area (East Delhi, across river Yamuna) and also links it to the neighboring state of Uttar Pradesh. The mass transit line runs parallel to the highway and forms the other means of access to the site. The Grand Trunk Road is a heavily traveled road with a large number of public busses, private automobiles and cyclists plying on it. Traffic congestion is a big problem on the road during peak hours. It is perceived that the coming of mass transit in the area will decongest the Grand Trunk Road. The stations for the metro rail are along the Grand Trunk Road and are accessed by commuters from it. There is a potential to redesign the road and have new development along it. This

[Fig. 5.29] Large open drain on the proposed site
Source: Author

[Fig. 5.30] Plan showing vacant sites along the transit corridor
Source: Eicher City Map

There are vacant sites along the transit corridor and in its surrounding areas. Since the transit line is at grade in this area, there is a possibility to develop these areas so that they form an interface between the new transit and existing developments.

[Fig. 5.31] Silampur station interior view
Source: Author

[Fig. 5.32] New development by Delhi Metro Rail Corporation at Shastri Park
Source: Author

Residents of Silampur are anticipating a change in property values and in the overall character of the area due to the new construction of transit stations and associated property development.

development can form a transitional element between the road and the surrounding resettlement colonies.

■ Design Considerations

Since there is a high level of residential development in the surrounding colonies it is proposed that the new development should have limited residential development. The focus should be to provide concentrated commercial development and public amenities which are lacking in the area.

A part of the development should also be dedicated to establish government offices as it will lend stability to the development.

The linear development can also expand into vacant plots of land like Shastri Park Depot which are along the mass transit line. These sites are owned either by the Delhi Metro Rail Corporation or the Delhi Government. Property development by private developers can be encouraged on such sites by forming new partnerships.

The potential development that can happen on such sites include information technology parks and non pollution industries. Over a period of time such uses will help establish an employment base in the region and would also change the image of the area.

[Fig. 5.33] Poor state of infrastructure provision
Source: Author

■ Elements of the Primary Area

A parallel road to the Grand Trunk Road has been constructed on the edge of the existing development and proposed site. The area between this road and the Grand Trunk Road has been divided into plots of 15 Ha.

These 15 Ha plots are then divided by internal roads to cater to different uses. Some of the uses proposed here are government offices, high density residential development, commercial functions, entertainment district, hotel, public amenities like schools and hospitals and a new recreational park.

[Fig. 5.34] Common scene in times of rain
Source: Raghu Rai

The park is desired as squatter settlements have come up in areas which were originally reserved for open spaces.

Linkages connecting existing areas on either side of the Grand Trunk Road are proposed. These will be through the site at both the grade level and also above in the form of sky walks. Such linkages would not only make amenities more accessible to residents but also help integrate the new development with the existing fabric.

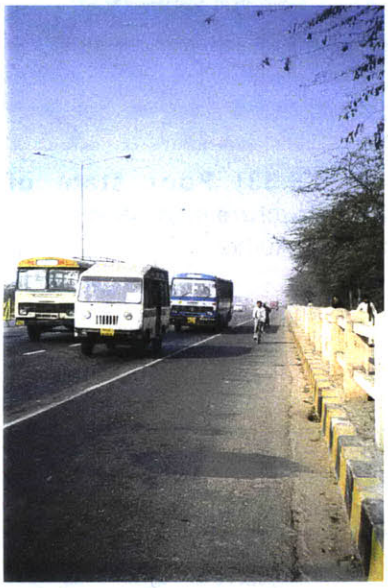
[Fig. 5.35] View of the main road till the year 2002
Source: Raghu Rai

■ Land Use and Development Character

Total number of people employed in the proposed development: 18,000

Total number of residential units in the proposed development: 18,000 (residential population: 90,000)

[Fig. 5.36] Trains are already functional in the area
Source: Author



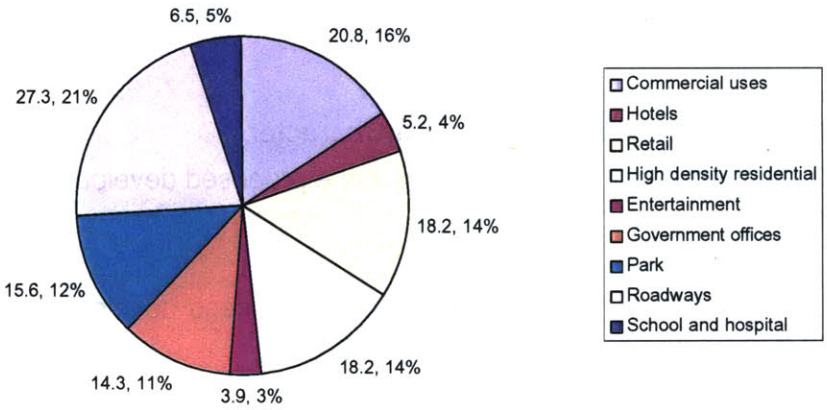
[Fig. 5.37] View of the main road after the introduction of transit - decongestion
Source: Author

[Fig. 5.38] Increase in number of cyclists on the road
Source: Author

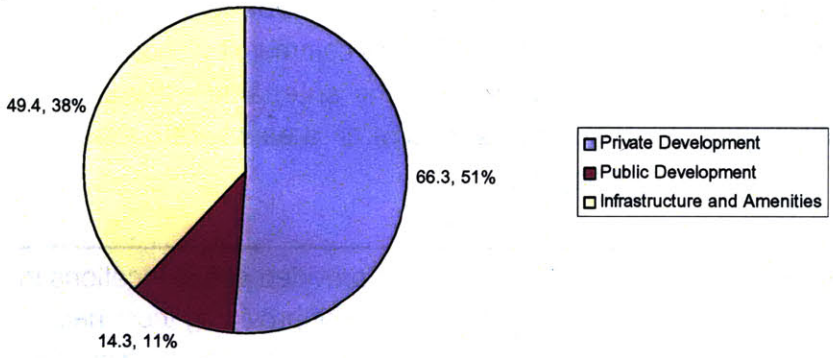
[Fig. 5.39] Land Use distribution in the proposed development
Source: Author

The figure below shows the proposed pattern of predominant land uses in the planned development area.

[Fig. 5.40] Land Use plan for the first intervention
Source: Eicher City Map

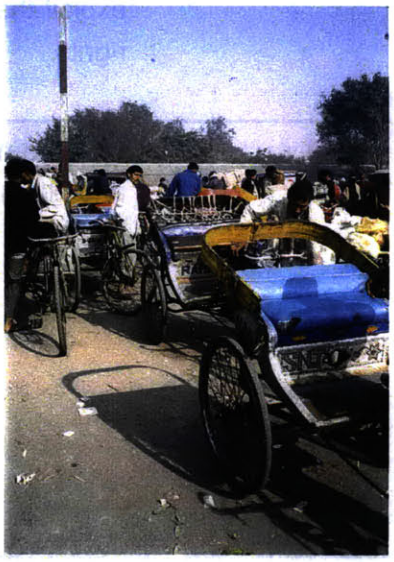


Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Private Development	**66.3**	**51**	**0.73**
Commercial Uses	20.8	16	0.23
Hotels	5.2	4	0.05
Retail	18.2	14	0.20
High Density Residential	18.2	14	0.20
Entertainment	3.9	4	0.04
Public Development	**14.3**	**11**	**0.15**
Government Offices	14.3	11	0.15
Infrastructure and Amenities	**49.4**	**38**	**0.54**
Park	15.6	12	0.17
Roadways	27.3	21	0.30
School and Hospital	6.5	5	0.07
Total Primary Area	**130.0**	**100**	**1.44**



[Table 5.6] Land use distribution in the new development
Source: Author

As can be seen in the figure above approximately 51% of the total area is given to private development and the balance is divided between public development (11%) and infrastructure and amenities (38%). Out of the 38% dedicated to infrastructure and amenities, approximately 21% is for public circulation. Expansion of the center may not be possible in the future due to the dense surrounding urban fabric but it may be possible to continue the development in a linear way forming nodal developments resulting in a high density mixed use development corridor. The following table shows the intended character of the proposed development.



[Fig. 5.41] Next step should be to think of modes of paratransit to service the stations
Source: Author

Land Use	Location on Site	Character
Commercial	Commercial areas are located in the northern part of the site close to the mass transit station.	The maximum amount of land in the proposed development is devoted to commercial functions. It is thought that commercial functions will do well in the area as the existing surroundings are predominantly residential in nature. They will also help change the image of the area. Exploitation of air rights over the national highway will be encouraged for commercial functions as it has the potential to integrate the surroundings with the proposed development. The FAR proposed for the commercial areas is 6.0 near the mass transit station. The size of these units is to be based on the following guidelines: Development Unit: 300m by 400m Blocks: 100m by 300m
Hotel	It is located across the national highway to encourage developers to exploit the potential of air rights.	The hotel has been proposed as a support development for the commercial functions. It is located close to the entertainment and retail uses so as to form an area where people can hang out.
Retail	Located next to the hotel and along the national highway.	Retail functions are provided at two locations in the site. The purpose of providing them next to the hotel is to form a zone of entertainment and leisure for the people. The other area where they are provided is next to the high density residential developments. This has been done so as to encourage a mixed use type of development where the retail functions serve the need for the residential population.
High Density Residential	It is located towards the southern side of the development.	Residential development is proposed for low and middle income group families. It is thought that families belonging to the above income

		brackets will prefer living close to transit nodes as it will limit their need for a private automobile. Also the residential development is to serve as a transitional element between the existing development and functions proposed along the national highway.
Entertainment	It is located close to the transit station and the hotel.	The area will have small scale restaurants, bars, retail, museums and theaters.
Park	Located towards the northern edge of the development.	An open recreational space is a much needed amenity in the area. The park is to be for both the proposed development and the existing neighborhoods.

[Table 5.7] Land use development character for the first intervention
Source: Author

5.4.3 PROPOSED DEVELOPMENT PLAN FOR THE SECOND INTERVENTION

■ **Silampur Colony Characteristics**

Silampur Colony, as one of the resettlement colonies in Delhi has over time undergone most of the transformations that have been mentioned earlier. To understand the area in detail the development and transformation of Silampur Phase 1 and 2 (plots with 67 sq.mt. and 21 sq.mt.) have been studied.

- **Origin**
  The settlement was established in 1962 to resettle squatters from existing slums in Delhi.

- **Location**
  It is located in East Delhi, across the river Yamuna, along the Grand Trunk Road.

- **Surrounding Areas**
  The site is flanked by the Grand Trunk Road on the south and Silampur Phase 3 on the east. Towards the north in a drain with several regularized unauthorized colonies.

[Fig. 5.42] View of the Silampur Market - a thriving area which caters to other surrounding areas as well
Source: Author

- **Site and Layout**

  The site measures 34.64 Ha consisting of 67 sq.mt. plots, arranged in nine blocks of varying numbers of plots along a central spine road.

- **Stages of Transformation**

1962

- Settling of a large number of squatters on a site at the outskirts of the city on plots of 67 sq.mt. with plinth and basic infrastructure.
- Some of the allottees move out of Silampur because of its distance from their work centers.
- The allottees begin putting up their shelters – one room to start with.
- Residents on plots along main roads and at corners begin setting up small commercial establishments in front of their plot, as a means of income supplementation.

1964

- Emergence of the first major home based economic activity – making incense sticks, this was soon taken up on a very large scale.
- Opening of more shops – commercialization confined to main roads.
- All houses provided with individual water supply and electricity.
- Slow pace of consolidation of properties.

1970

- Establishment of another significant home based industry – manufacturing garments for export.
- Growth of unauthorized colonies around Silampur- which depended on Silampur for shopping and schools.
- Increase in commercial activity.
- Improvement in economic levels of people.
- Consolidation of properties continues – though only on ground floor.

1975-76

- Resettlement during Internal Emergency in 21 sq.mt. plots in small pockets between and around the initial settlement.
- Increase in commercial activity.

1978

- With regularization of the unauthorized colonies around Silampur and growth of more colonies, Silampur flourished as the main shopping area.
- Emergence of shopping streets and commercialization extended into secondary roads.
- Disappearance of front yards in almost all houses along the vehicular access roads.
- Encroachment onto road beyond plot lines, sometimes upto one shop depth.

1980

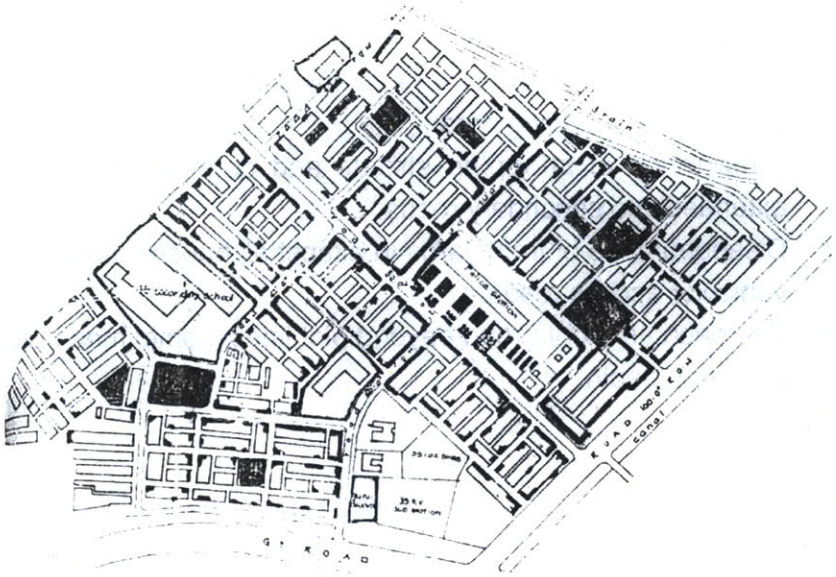
- Establishment of other home based industries like wire works.
- Almost 70% of plots have some form of economic activity on them.
- Commercialization extended onto smaller roads and pedestrian paths.
- Consolidation of properties – consolidation extending vertically
- Growth of squatters within the colony in large numbers.
- Emergence of rental housing market and rental commercial market.
- Emergence of factories in residences, displacing housing.

1985

- Increase in property values and further increase in commercialization.
- Consolidation of properties faster, expanding vertically to more than two storeys.
- More squatters settling within the colony.
- Tremendous increase in property values and rental values for commercial space.

1990 – till present

- More industries flourish in the area.
- Collapse of infrastructure because of increasing population densities.
- Government passes bill, ordering all polluting industries to move out of the area.
- Announcement of the metro rail project starting from the area.
- Currently people are anticipating a change in development in the area and expecting an increase in property prices.



[Fig. 5.43] Plan of Silampur Phase One and Two
Source: Author

■ Development Interventions

It is perceived that different parts of Silampur would transform in their own unique ways, depending upon the existing fabric and socio-economic profile of people that reside in these areas. Transformation could either happen as a result of market forces or be planned for by government intervention. Government intervention would be the preferred mode of development, as new infrastructure will need to be coordinated with the existing and proposed development. New partnerships could be formed between the public development agency, non-governmental organizations, community and private builders to transform the area.

[Fig. 5.44] Existing area is already densely developed
Source: Author

■ Existing Situation and Perceived Transformations

As described earlier the low income housing area is already densely developed and there may not be much vacant space in the urban fabric for new buildings to be accommodated. However with the advent of the metro rail there would be transformations which could lead to a new development pattern in the area. Following are transformations that one would perceive to happen in the low-income housing colony:

- **Change of Land Use**

  Presently Silampur Phase 1 and 2 is a housing area that has a high level of mixing of uses (especially commercial and residential) which has, in addition to local users and

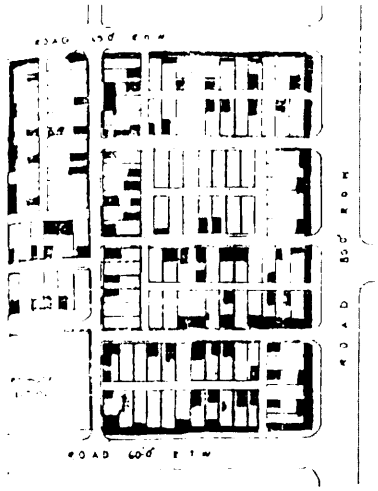
consumers, extraneous users who find the area attractive for its location and extraneous consumers who depend on it to meet their needs. Commercialization is extensive along all vehicular roads. The shopping streets along with the central market currently cater to all income levels. Most of the shops in the area are either encroachments or have been built in the area meant for the front court. In the buildings, commercial use is restricted to the ground floor with most plots having at least two shops. At a block level, about 55% of plots have shops and only 27% of the plots are purely residential. The table below shows the original land use planned for the complete area with the present situation:

[Fig. 5.45] Informal mixed land use - residential with home based industries
Source: Author

Land Use	Initial Area (Ha)	% Initial Land Use	Present Area (Ha)	% Present Land Use
Residential under plots	8.74	25.23	10.52	30.37
Commercial	1.53 (150 Shops)	4.4	0.50 (1258 Shops)	1.49
Community Facilities				
- Schools	3.31	9.5	2.42	7.0
- Health Center	0.32	0.93	0	0
- Religious and Misc.	0.68	1.97	1.10	3.18
Open Spaces	4.85	14.0	4.85	14.0
Roads and Pathways	9.30	26.87	10.28	29.7
Area for future housing	5.86	16.94	0	0
Industrial	0	0	0.97	2.8
Area Undefined	0	0	3.96	11.45

[Table 5.8] Table highlighting the difference between the original and present landuse
Source: Author

There is a significant increase in commercial development but the overall area for commercial land use has decreased. This is an indicator of the high density of development and an increase in informal mixed land use.



[Fig. 5.46] Typical block level plan in Silampur
Source: Author

The land use distribution at a block level is shown in the table below:

Nature of Activity	Number of Plots	%
Residential	40	27.7
Residential + Commercial	60	41.66
Residential + Home Based Industries	23	15.97
Residential + Commercial + Home Based Industries	20	13.88
Residential + Commercial + Factories	1	0.69
Residential + Factories	1	0.69
Total	**145**	**100**

[Table 5.9] Land use distribution at block level
Source: Author

The nature of commercial activities and their distribution is described in the table below:

Hierarchy	Spatial Distribution	Degree of Consumers	Size of Shops (mts)	Performance	Established Time (Years)
1	24m Central Spine Road	Very High	3.0 by 3.0	Low and Medium	15 Years
2	18m and 14m wide secondary roads	High	3.0 by 3.0 2.4 by 3.0 2.4 by 2.4	Medium	10 Years
3	Inner access roads	Medium	2.4 by 1.8	High	10 Years

[Table 5.10] Distribution of commercial activities
Source: Author

The factors for such a development pattern for commercial land use has been a combination of unplanned development coming up in the surrounding areas (they depend on Silampur for their needs) and larger than planned population occupying the residential area.

Home-based economic activities are also well established in the area and at the block level about 30% of the plots have them. Since these activities are non-polluting in nature the government has no restrictions on their being present in the area. Till a few years back there were a lot of factories in the area, but a government bill ordered to close all such polluting units. Hence today there are hardly any factories left in the area. This has also caused a drop in property value.

[Fig. 5.47] Unplanned commercial development with residential land use
Source: Author

Land use for open spaces, community facilities and amenities has either remained same or decreased over the years, mainly due to squatter settlements encroaching on public land and open spaces. There are a lot of squatter settlements along drains and on the periphery of the settlement.

The coming of the metro rail will enhance the property value in the area. Initially this would lead to more commercial development, followed by mixed use development of residential and commercial plots. Large surrounding sites on train depots like Shastri Park are open for development and presently there is speculation of functions like an information technology park coming in the area. This would potentially lead to an image change and more residential development in the Silampur area. For the government agency, the level of intervention suggested is to enhance the existing infrastructure and provide public amenities like medical facilities, schools and open spaces. These are currently much needed in the area. The Delhi Development Authority should allow for mixed use development as it would encourage home based industries with residential buildings. This would lead to an overall job housing balance in the city. Building regulations should also be strictly reinforced in the area to make sure that existing buildings are structurally stable and streets are free of encroachments.

[Fig. 5.48] View of the initial housing provided by DDA
Source: Author

- **Density**

  Changes in family compositions over time have resulted in extended families. This along with rental housing and emergence of squatters has resulted in an increase in density. The population density has increased six times in the last forty years.

[Fig. 5.49] Vertical expansion has accompanied an increase in density
Source: Author

[Fig. 5.50] Informal development at the edge of the planned development - absence of any building regulations
Source: Author

[Fig. 5.51] View showing additions made by residents to the housing provided by DDA
Source: Author

- Gross Density
  Designed (only with 67 sq.mt. plots): 40 du/ha
  Existing (including 20 sq.mt. plots): 76 du/ha

- Net Density
  Designed: 112 du/ha
  Existing: 239 du/ha

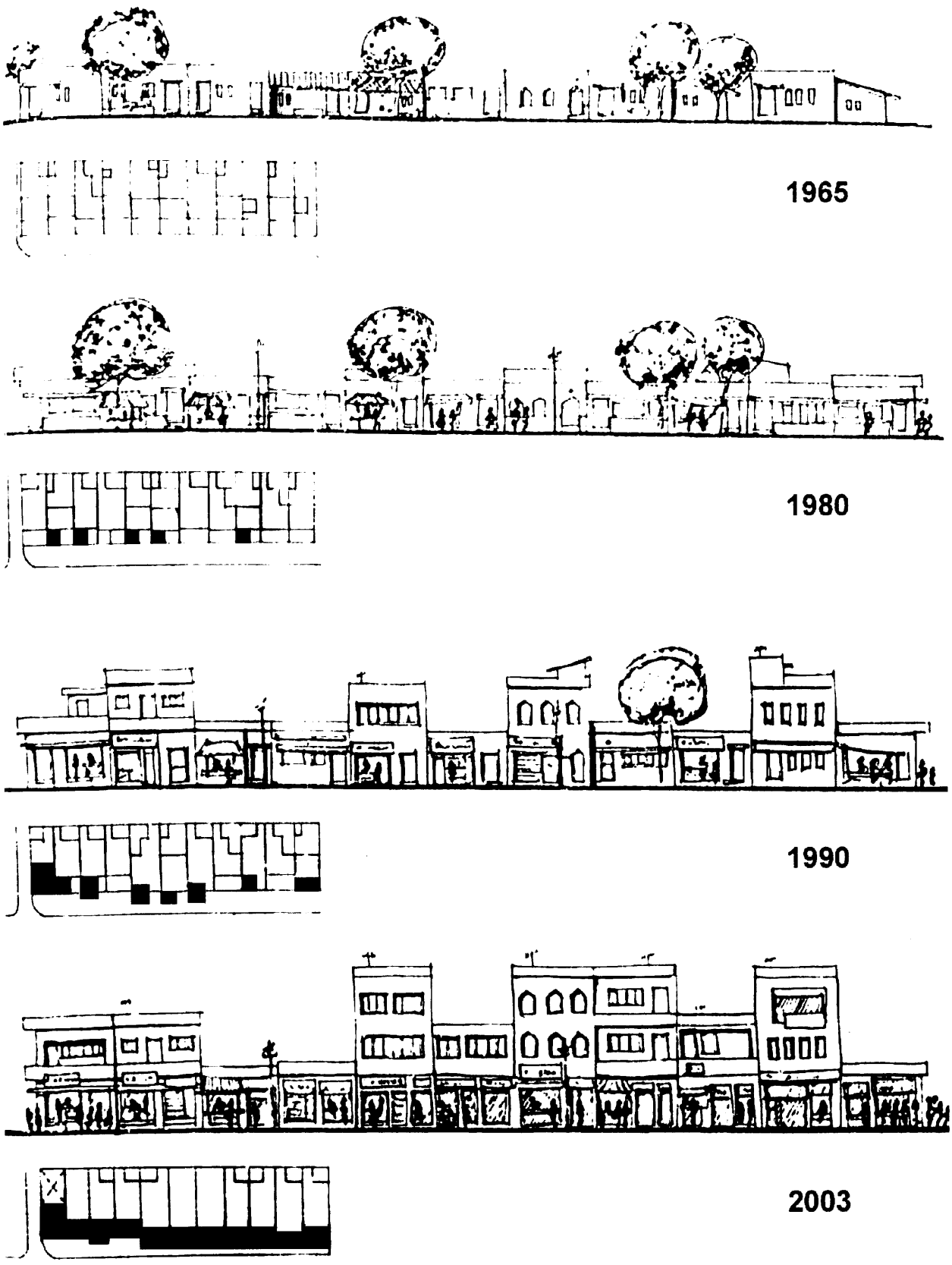
- Population Density
  Designed Gross: 200 ppha
  Designed Net: 560 ppha
  Existing Gross: 608 ppha
  Existing Net: 1912 ppha
  Existing with squatter gross: 1177 ppha

The dwelling unit density is very low compared to the standard Master Plan density of 85 du/ha for single storey structures. The prescribed FSI (floor space index) at the time of planning was 0.6 but today 65% of plots have a FSI of more than 1.00. The predominant range is between 1.01 and 1.05. Hence nearly 75% of households have more than or equal to four habitable rooms, while only two habitable rooms were envisaged originally. The maximum number of rooms observed was seven and minimum was one per household.

Nearly 75% of households have occupancy rates less than or equal to 3.0 while the envisaged rate was 2.5. As against the envisaged one household per plot, only 40% of plots have more than one household per plot, 30% having two households and 10% having three households per plot. The average number of households per plot is 1.4.

The most commonly encountered size of rooms is 4.87 m by 3m, 4m by 3m and 4m by 2.4m. One finds both amalgamation and subdivision of plots, while subdivision of plots mainly occurs along main roads/vehicular access roads account for about 15%, amalgamation is only about 1.4%.

Subdivision of plots in most cases is done for economic returns and in a few cases due to family feud. Amalgamation of plots was possible because in a few cases adjacent plots were



[Fig. 5.52] Diagram showing the increase in density and commercialization over the years
Source: Author

[Fig. 5.53] Encroachments on the street
Source: Author

allotted to members of the same family and in some cases purchased by the owner.

It is perceived that one of the impacts of the mass transit will be in the increase of land value in Silampur. This would encourage small scale private developers (presently they are absent in the Silampur area) to invest in the area. It has been observed that private developers prefer to amalgamate plots and develop group housing due to financial considerations. Typically each of these housing projects has one to two families per floor and is four to five floors high. A large rental population in the area will make such schemes viable. This development process over time would lead to a more uniform spread of population in the area and would increase the number of households per plot but decrease them per dwelling unit. It would also lead to bigger plots and more mixed use development.

- **Built Form and its Relation to Open Space**

Settlement Level

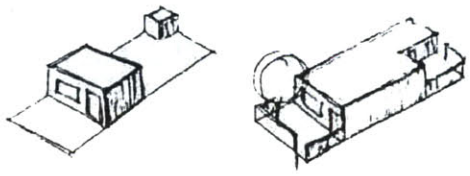
At the settlement level, the built mass is not very intensive. With the large scale of plot sizes, roads and pathways the settlement has a feeling of openness, which is in no way diminished as one enters a pedestrian path from the main road.

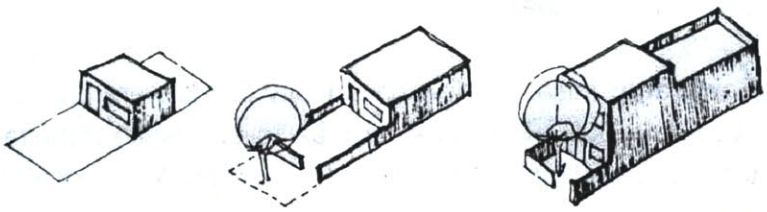
[Fig. 5.54] Consolidation of commercial and residential
Source: Author

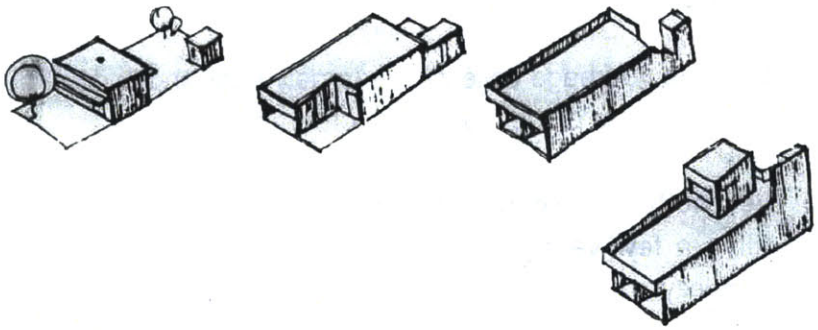
Most structures are either single or double storey, whether on vehicular access roads or otherwise. The large scale of roads has given rise to encroachments. Encroachments are common and are some time about 3 m in depth. In the majority of the cases the encroachments are only 1-1.5 m in depth. In terms of built form the fabric of the settlement appears homogenous almost throughout the settlement.

Block Level Consolidation

About 38% of the plots have full plot coverage and 62% have partial coverage. There are no vacant plots in the colony. About 35% of plots have consolidated only up to one storey, 45.8% up to two, 18% up to three and only 0.7% up to four storeys. About 40% of plots have encroached in the public space in front of the house[21]. Along main roads the encroachments



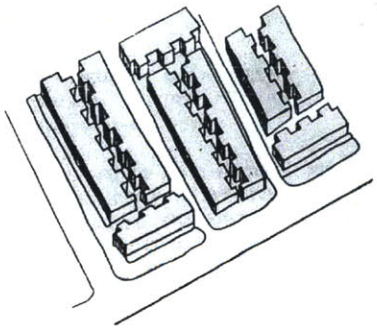


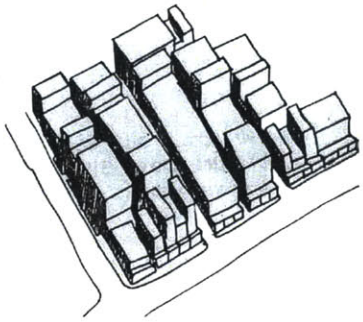


[Fig. 5.55] New developments in the area indicate local developers consolidating plots
Source: Author

[Fig. 5.56] Illegal addition to original built structures
Source: Author

[Fig. 5.57] Diagram showing vertical expansion of residential units
Source: Author





[Fig. 5.58] Diagram showing expected transformation
Source: Author

are up to 3 m and accommodate shops. In the internal lanes, the encroachments are only up to a maximum of 1.5 m.

The main reason for consolidation beyond the envisaged is due to the increased family size and affordability per household. Absence of any regulation against consolidation also encourages it.

The consolidation of properties does not cause any negative impacts though in case of plots with 100% coverage the inner rooms do not receive light and ventilation, but these are factors which are not important to the residents. The advent of the mass transit line is going to increase density in the area and

this would be visible in the built fabric by additions in the number of floors in existing buildings. Thus there will be a vertical increase in density accompanied with consolidation of plots.

- **Infrastructure**

Physical Infrastructure

Water Supply: Initially, water supply was on community basis but soon individual water connections were provided.

Sewerage: Initially, a few community toilets were provided but today 100% plots have individual toilets inspite of the fact that no sewer lines have been laid in the area. All sewerage is emptied into surface drains.

Drainage: The initial provision of shallow surface drain still continues. Many homes have low plinths which are prone to flooding in case of heavy rains.

Garbage: Garbage collection is largely poor and is done by the employees of the municipal corporation.

Electricity: Individual connections to plots were provided within a few years of resettlement. Today all plots have electricity but some maybe from illegal sources.

Roads and Pathways: These are in poor condition and there seems to be no government initiative in this regard. The main vehicular roads are 24m, 18m, 14m, and these experience heavy traffic congestion during peak hours.

Social Infrastructure

Schools: There are hardly any schools in the area.

Health Facility: The site that was meant to have the health center is now converted into a park and hence residents depend on local clinics. A lot of these clinics are illegal.

Community Halls: The area that was meant to have a community hall now has a police station. Hence there is no facility for community gatherings.

Shopping: None of the planned local shopping centers have been built. Presently only the central market serves the residents daily needs.

It is apparent from the survey that the area lacks quality physical and social infrastructure. Though the advent of the transit system may not have a direct impact on its provision but with an increase in investment in the area because of either new projects or consolidated development, it is felt that the government agency will take the necessary steps to provide better infrastructure facilities.

- **Socio Economic Transformation**

Economic Profile

There has been a tremendous shift in the economic profile of the people in the area. The employment split shows that about 61% residents are self employed, 20% are in government service and 1% are in private companies. The large self employment is due to home based industries.

Household Size

The average household size has doubled from 4.0 in 1962-63 to 8.3 today as was revealed by the primary survey.

Vehicle Ownership

About 50% of households have cycles, 30% two-wheelers and 20% both cycles and two-wheelers.

Over the years the economic position of families has stabilized, the number of earning members has increased. This has resulted in an overall rise in economic levels of households. The high degree of commercialization and establishment of home-based industries have supplemented income.

The metro will further improve the economic condition of the people and this will be reflected in the extent of consolidation, external finishes and type of shops required.

- **Tenure and Rental Profile**

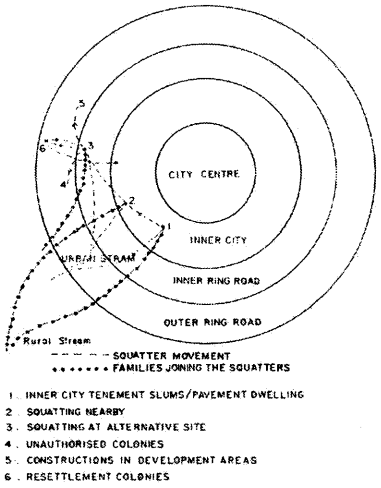
Surveys reveal that today only 49% of plots contain original allottees while 51% contain non-original allottees[22]. A majority

of these non-original allottees are from within the city – 77.78%, about 78% of sale of properties took place between 1971-80, with the properties changing hands more than once.

Rental housing is not very prevalent here. Only 20% of the plots have tenants. The number of tenant households per plot varies from one to three. About 70% of shops are owner operated while 30% are on rent. The establishment caters to both local demand and demand from the surrounding areas (Local demand: 44%, Demand from surrounding areas: 56%). A majority of the shops, about 50% were established between 1962-70, 33% between 1971-80 and 11% before 1970[23].

The main reason for purchase of property or rental housing at Silampur is its advantageous location – proximity to Old Delhi, Inter State Bus Terminus (ISBT), Shahdra etc. and affordable price of properties and rental housing. The high incidence of non original allottees shows that the resettlement has not ultimately catered to the people it was supposed to.

It is perceived that the mass transit system will increase rental housing in the area. This will be mainly due to the fact that poorer communities who wish to have tenure will prefer to migrate further out of the city to places which are accessible by the mass transit system. The area will see more residents from lower middle and middle income group wanting tenure as it would be an area in the city which they will be able to afford and one which is easily accessible by the transit line. The increase in rental population will be primarily due to new work centers being established along the transit line in the high density corridor and families wanting additional income by renting parts of existing or new structures.



[Fig. 5.59] Typical movement of a squatter in Delhi
Source: Government of Delhi

5.4.3 PROPOSED DEVELOPMENT PLAN FOR THE THIRD INTERVENTION

The squatter settlements in the Silampur Colony are towards the periphery. It is believed that the advent of mass transit in the area would provide an opportunity to transform the squatter settlements. This transformation will happen mainly due to the new investment in the area along with a changed image and a high density development along the transit line. The creation of the squatter

settlements in the area is the consequence of poverty and inability of the authorities to provide adequate infrastructure for the poor. Thus it is recommended that a framework be established that will assist people living in the squatter settlement to improve their living conditions and alleviate their poverty.

[Fig. 5.60] Distant view of the squatter settlement
Source: Author

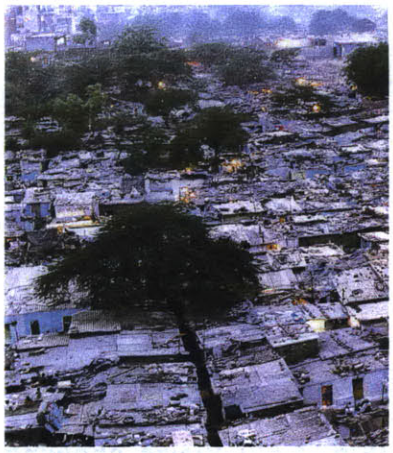
The Delhi Development Authority along with other government agencies has implemented a series of policies to address squatter settlements. Squatter clearance programs and creation of resettlement colonies have been some of these policies. In recent years there has been a change in the attitude and strategy of the development authorities. Since 1991 the following three strategies have been used in Delhi:

- Extension of the Urban Basic Services Program (UBSP) through Environmental Improvement
- Relocation
- In situ up-gradation

Each of these programs is viable for the up-gradation of squatter settlements in the Silampur area. In the following text, these programs have been described and key issues for each of them have been identified.

- **Environment Improvement Project**
  This program was started in 1987. It is implemented in those squatter settlements where the other two programs of relocation and in-situ upgradation are not being implemented. It involves the provision of basic urban services and amenities. Some facilities that are provided under this scheme are:
  - Pay and use toilets
  - Water supply through hand pumps / water tankers
  - Street lighting
  - Dustbins for collection of domestic waste
  - Paved pathway and drains

  Key Issues and Problems
  - Standard norms for basic services are too low
  - Inadequate environmental infrastructure
  - Ineffective delivery and service mechanisms
  - Lack of information about the existing infrastructure
  - Community apathy towards environmental improvement



[Fig. 5.61] Squatter settlement next to Silampur
Source: Author

- Lack of consultation between authorities, NGO and community

- **Relocation**

The resettlement or relocation scheme was started in Delhi for the re-housing of squatters on Government and private lands in 1960. Silampur is an example of one such resettlement colony. The scheme started with allotting two room tenements, subsequently partially developed plots of 67 sq.mt. were given and later these were reduced to 40 sq.mt. and then to 20 sq.mt. Under the present situation, relocation is carried out for only those squatter settlements that occupy land which is required by the government for public interest projects. The land owning agency along with the resident and the government has to bear the cost for relocation.

Key Issues and Problems

- Scarcity of land for relocation
- Relocation sites are on the periphery of the city
- Standards are not attractive to pursue people to move
- Size of plots does not conform with social needs
- Land tenure not granted
- Locations for employment are not considered
- Transport and other infrastructure not adequate
- Financing mechanisms and affordability not appropriate

- **In-situ Upgrading Program**

The scheme involves the re-planning of dwelling units in modified layouts by redistributing the encroached land pockets amongst the squatter families. The housing plots are generally designed as clusters around open courtyards. The beneficiary constructs the shelter under a self help scheme with technical help provided by the government agency.

[Fig. 5.62] Views showing transformation of the squatter settlements
Source: Author

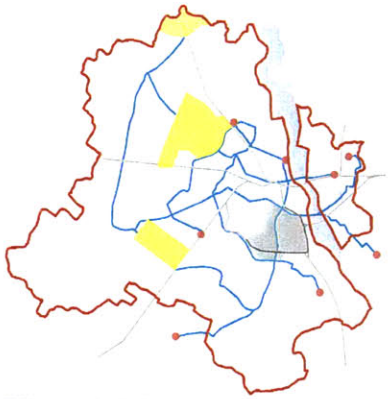
Key Issues and Problems

- Resistance by the land owning agency to release land
- Size of plots to small for constructing proper shelter
- Lack of consideration given to the physical layout in the context of social and cultural aspects of the community
- No granting of land tenure
- Poor community involvement and the role of the NGO

5.5 KHYBER PASS: HIGH DENSITY URBAN DEVELOPMENT ON NEW LAND BANK

Khyber Pass, a property owned by the Delhi Metro Rail Corporation (DMRC) has become accessible to the city due to the link provided to it by the metro rail. Part of the Khyber Pass site is to have an underground depot for train maintenance and the remaining is to be developed by DMRC in partnership with private developers for commercial real estate development.

Development on the site has been proposed according to the regulations of the DDA as per the overall Master Plan for the city. This case is an attempt to propose a development pattern for such sites which encourages high density along with mixed use development. There is an idea here for an integrated development approach where uses are mixed not just horizontally but also vertically, thus generating new movement patterns.

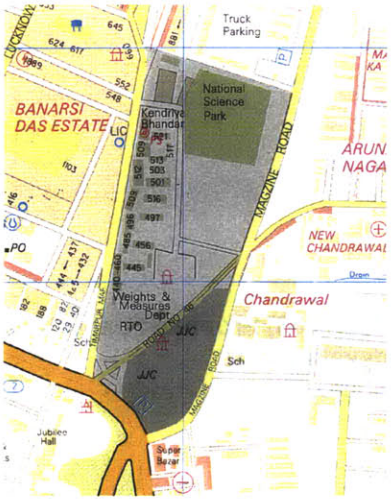


[Fig. 5.63] Plan showing areas in the city which have characteristics similar to the Khyber Pass Development
Source: Author

5.5.1 PROPOSED DEVELOPMENT PLAN

■ Description of the Proposed Site

The site is located at the intersection of Mall Road, Timarpur Road and Magazine Road and is approximately 4km. from ISBT which is a major transportation interchange. It is surrounded by well developed low-density residential areas such as Civil Lines, Kingsway Camp and Kamla Nagar. A new district centre by Delhi Development Authority is also proposed in the area. The entire north campus of Delhi University is located adjacent to the site.



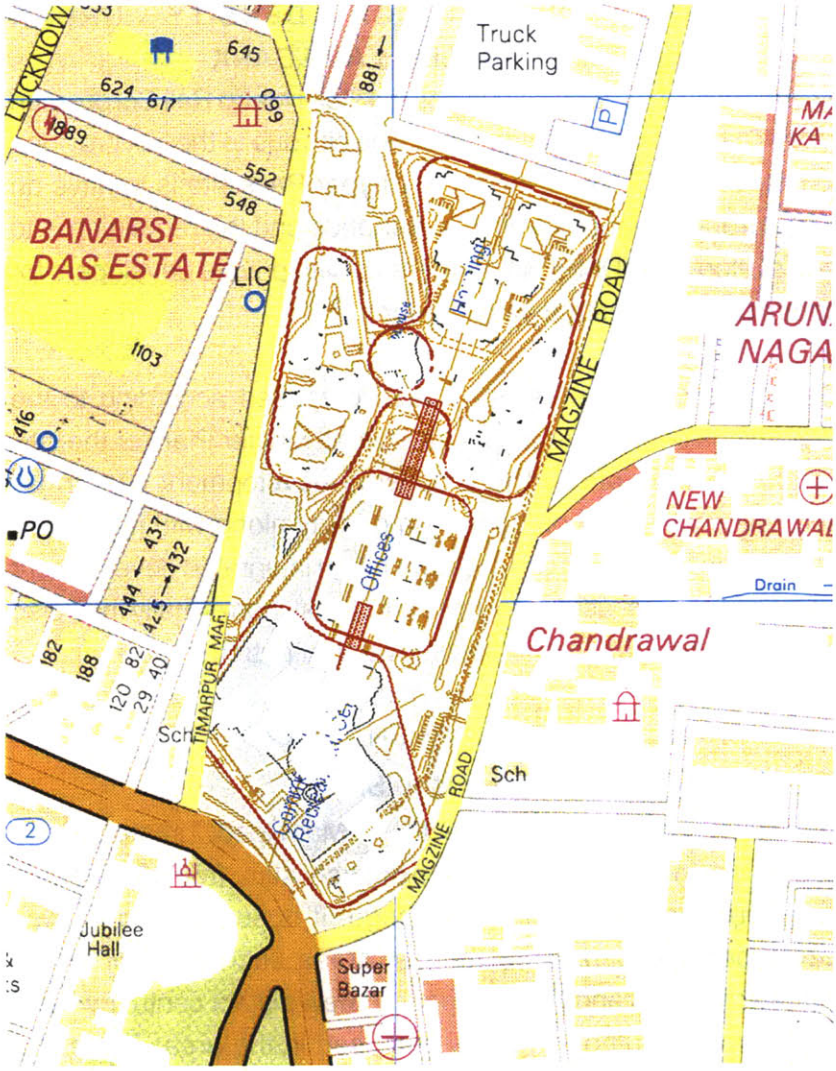
[Fig. 5.64] Khyber Pass site plan
Source: Eicher City Map

■ Development Plan

DMRC intends to develop Khyber Pass as an example of a large scale commercial development which not only generates revenue but through a mix of uses creates an atmosphere conducive to good living and social enjoyment. As it will be one of the initial sites developed by the metro corporation, its success will be crucial for the realization of similar future developments.

Market surveys and feasibility studies conducted by private real estate firms on behalf of DMRC indicate that the site has potential to sustain a well planned commercial complex. This is considering various factors such as good location, catchments and accessibility of the site. Surrounding residential development along with Delhi

[Fig. 5.65] Site View
Source: DMRC



[Fig. 5.66] Proposed pattern of development
Source: Eicher City Map

University provides ample catchment for business development to occur on the site, besides the opportunities introduced by mass transit connectivity.

Khyber Pass offers a unique opportunity to utilize airspace above the track in the form of a deck. Depending upon the design for the site the deck can be developed either as a landscape area or can be built upon. This part-decking of the tracks and depot utilities makes the entire scheme developable which otherwise would lead to a highly constrained and fragmented site due to track alignment. Thus the deck combined with land parcels on the ground would provide sufficient amount of land for developing a viable scheme.

[Fig. 5.67] Site View
Source: DMRC

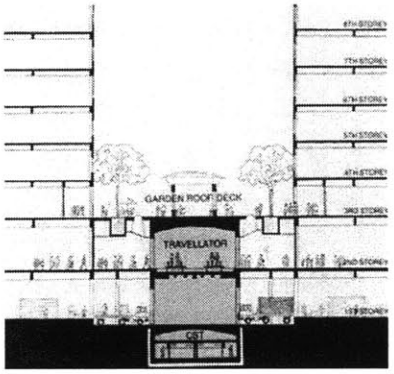
Uses envisaged for the site include commercial functions coupled with residential development. Target segments that could benefit

from such a development would include enterprises in the entertainment industry such as cinemas and multiplexes, services of the nature of retail chains and fast food and offices for professional services and businesses.

■ Elements of the Proposed Development

Some ideas for the proposed development include the following:

- A focal development to strengthen mall road urban context.
- A logical termination to the ridge with public activities along the mall road.
- Entry to commercial area along magazine road with separate entry to housing.
- Pedestrian zone along the deck linking all activities.
- The site could be organized in three separate zones with commercial, office & housing with the most public along mall road or there could be an integrated development dividing these uses vertically. The later strategy will require infrastructure to be laid in advance of development.
- Each activity could be independently planned with its own environment or they could be linked by skywalks, travelators and lifts.
- Articulation of pedestrian public spaces would form the main articulation feature.
- Each activity has a focus of landscaped open spaces.
- All public spaces are interconnected to form a composite whole



[Fig. 5.68] Proposed garden roof deck. High density development with nature.
Source: Author

Type of Development	Area (Ha)	Plot
Proposed Commercial Development	2.20	PLOT A
Proposed Mixed Use Development (on ground)	5.68	PLOT B
Proposed Mixed Use Development on Deck (at 25% of residual depot area)	6.53	PLOT C
Residual Depot Area	19.59	
Total Area of Depot	34.00	

[Table 5.11] Development split proposed on the site
Source: Author

■ Land Use and Development Character

Plot	Proposed Development	Area (sq.mt.)	Ground Coverage (sq.mt.)		Floor Area (sq.mt.)	
Plot A	Proposed Commercial Development	22,000	5,500	25%	22,000	FAR 100
Plot B & C	Proposed Mixed Use Development (On ground + deck)	122,100	40,293	33%	203,907	FAR 167

[Table 5.12] Development split by plot (above)
Source: Author

Plot Area	22,000 sq.mt.
Ground Coverage (25%)	5,500 sq.mt.
Floor Area (FAR 100)	22,000 sq.mt.
Parking Spaces	292.6 ECS
Area Required	0.88 Ha
Shops @50% of total floor area	11,000 sq.mt.
Occupants in shops @6 sq.mt./person	1,833
Visitors @5 times employees	9,167
Offices @50% of total floor area	11,000 sq.mt.
Occupants in offices @10 sq.mt./person	1,100
Visitors @3 times employees	3,300
Total number of people on Plot A	**15,400**

[Table 5.13] Plot A: Commercial development
Source: Author

Plot Area	122,100 sq.mt.
Ground Coverage (33%)	40,293 sq.mt.
Floor Area (FAR 167)	203,907 sq.mt.
No. of DU's @ 95 sq.mt./DU	2146
Population @ 5 persons/DU	10,732
Parking Spaces	2711.96 ECS
Area Required	8.14 Ha

[Table 5.14] Plot B and C: Mixed use development
Source: Author

Facilities to be provided	Nos.	Area/Unit (Ha)	Total Area (Ha)
Recreation			
Tot lots	43	0.048	2.08
Parks			2.16
Play Area			2.16
Education			
Nursery School	4	0.08	0.32
Primary School	2	0.4	0.8
Senior Secondary School	1	1.6	1.6
Health			
Nursing Home / Dispensary	2	0.1	0.2
Shopping			
Local Shopping including service center	1	0.46	0.46
Convenience Shopping	2	0.11	0.22
Other Community Facilities			
Milk Booth	2	0.015	0.03
Religious	2	0.04	0.08
Community Room	2	0.066	0.132
Community Hall and Library	1	0.2	0.2
Utility			
Overhead Tank	1	0.25	0.25
Electric Substation			0.025
Three Wheeler Stand	1	0.05	0.05
Total Area required for social infrastructure			**10.77**

[Table 5.15] Area calculation for infrastructure provision on plots B and C
Source: Author

Hence the total number of people that can be accommodated on the site is 26,132. It is proposed that new systems of access be explored in the design of buildings. Skywalks and travelators will be encouraged to promote the mixing of uses. Common services tunnel may be adopted to provide infrastructure in advance of development. It is conceived that the project would convey an image of high density development within a green environment.

5.6 BAWANA: FUTURE HIGH DENSITY MIXED USE CENTER AT THE URBAN FRINGE

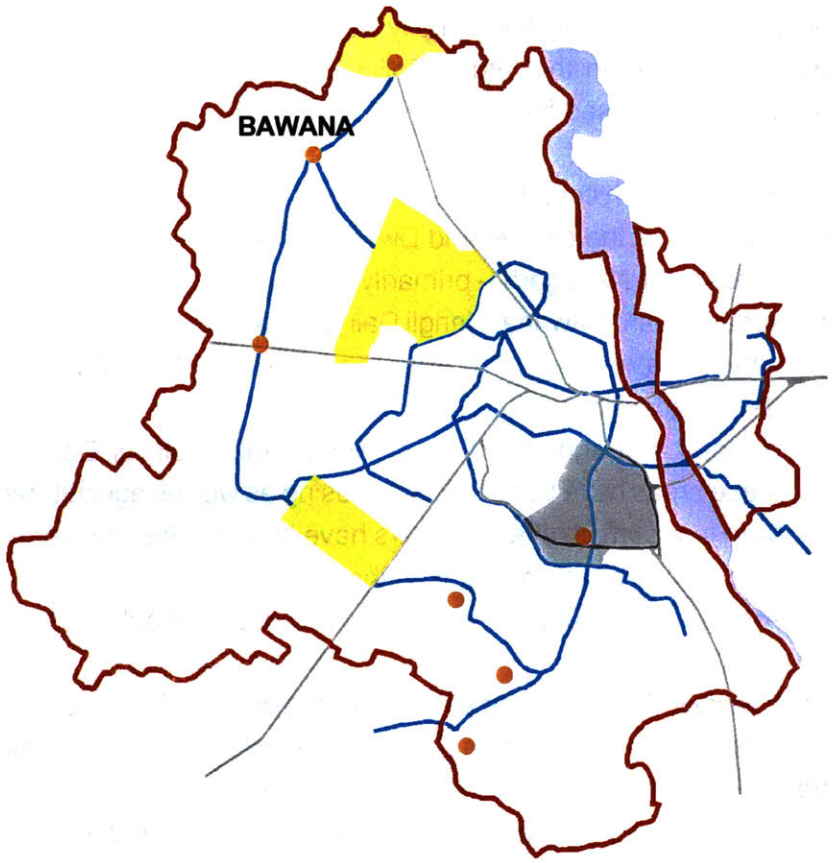
This model of development proposes to create high quality living environments by constructing a series of high density, mixed use centers in the rapidly developing fringe area of the city. This will help in restructuring the city's outlying areas. These centers are not intended to be similar to the already present district centers in the city of Delhi. The difference between the two models being the following:

- Unlike district centers, the proposed centers are to be islands of high density development in the suburban areas
- They would promote the mixing of residential with other land uses to form self sustainable planned developments
- The development strategy for these centers will encourage more private initiative, with the public agency having a well defined limited role in the development process.

They are also intended to be different from existing sub-city projects like Dwarka, as the project size of the proposed centers is much smaller and the goal is to treat them as extensions of the main city which would define future urbanization at the fringe, rather than isolated townships which are alternate centers of growth to the main city.

The components of such a development would include high density housing, employment generating functions, commercial areas, educational facilities, institutions, public recreational spaces and other basic infrastructure. A series of such centers are proposed at the outskirts of the city along the new mass transit line so as to give them excellent connectivity with the main city. They would also be connected with a system of expressways to give good automobile access. Such centers would be an attempt by the government to demonstrate that through planned development high quality living environments can be created. The main goals of such developments would be the following:

- Limit the extent of urban sprawl
- Promote a job-housing balance in suburban areas
- Provide a healthy mixture of housing for all income groups
- Promote the use of mass transit in suburban areas for commuting



[Fig. 5.69] Proposed locations for Bawana Prototype of developments
Source: Author

- Concentrate commercial and employment growth in outlying areas of the city
- Demonstrate an improvement in the quality of life in outlying areas
- Assure the installation of infrastructure in advance of development
- Limit the role of the public development agency in the development process by introducing new forms of public private development in the building of these new centers

An attempt has been made here to demonstrate this pattern of development on one site in the city. The site chosen lies in Bawana which is towards the west of the main city, a direction in which Delhi has been rapidly expanding in the last few years. The Bawana area is also marked as one of the future growth centers for the national capital region of Delhi, in the National Capital Region Plan. The area is to be connected by the mass transit line in the coming years. There are many other sites where such developments are possible on either almost vacant land or areas

which have extremely low density development and hence can be consolidated in the future. Following are some of the sites which could be used for such developments:

- Future growth centers as per the National Capital Region Plan
- Outskirts of the city beyond Dwarka sub-city development
- Areas near Najafgarh – primarily industrial development
- Areas toward Bawana, Nangli Dairy and Narela - all are areas which have informal housing and rapid unplanned development
- Villages and agricultural land towards the south of Delhi – these areas have both informal housing as well as agricultural farm lands which over the years have become the residential estates of well to do people in the city
- Area close to Nagal Dairy close to the International Airport

The nature of functions and structure of the development projects will vary by location of the site in the city but the overall development goals will remain consistent. As part of the development strategy for such centers it is proposed that initially a primary area of about 150 to 300 Ha is developed around metro stations which will be followed in the subsequent years by the surrounding development. The idea being that the government will plan the primary areas and development around it in the later years will be guided by the structure plan for the city. Hence the development of primary areas will help structure the surrounding fabric at the fringe.

5.6.1 PROPOSED DEVELOPMENT PLAN FOR THE BAWANA HIGH DENSITY MIXED USE CENTER

The chosen area for the project lies in Bawana which is towards the west of the main city, a direction in which Delhi has been rapidly expanding in the last few years. Some of the master planned sub city developments like Dwarka and Narela are proposed in this region. Thus the proposed site is in the future high development zone at the periphery of the main city. The new mass transit system is to give access to the site in the future and it being located at the junction of two transit lines there is a potential for it to become an excellent transfer point connecting future developments in the west zone with the main city of Delhi. The site is also connected by an existing roadway, which can be further

enhanced to provide express bus services and efficient automobile access. The Bawana center will in total cover an area of 1500 Ha out of which 150 Ha will be developed initially as the primary area of the center with high density development.

■ Description of the Proposed Site

At present the site is mainly open with some low-density informal housing on it. It is largely undeveloped and used for agriculture though the Delhi Development Authority has zoned it for residential land use in the future. The immediate surrounding of the site has towards its east and west a mix of informal housing and plotted development. The area towards the north has a mix of informal settlement housing with small-scale industrial units, and to the south there is small-scale commercial and residential development.

The site is bound towards the north and south by district level roads, towards the east by a major road of the region and towards the west by another development zone. The mass transit line is to be aligned to the southern edge of the primary development area. It is expected that the area will change rapidly once the mass transit line is built there.

Recently as part of the subdivision process the Delhi Development Authority proposed a new major road in the area and this passes through the site. It has the potential to form an important link in the development of the primary area. For the area to achieve rapid urbanization it is essential for it to serve as a transfer node for population in both the primary area as well as the surroundings. To achieve this it will be required for the primary area to have an intermodal center which would help people transfer from feeder bus networks, private automobiles, mini-busses to the two mass transit rail lines.

■ Design Considerations

It is intended that the center will be self sufficient in nature and will play a strategic role in the development of the surrounding fringe area. The center will need to anticipate and invite new industries and commercial uses in order to attract jobs into the area. Delhi has a policy of shifting heavy polluting industries from

its city core to nearby states. As the proposed center lies near the state boundary there is an opportunity for these displaced industries in the surrounding states to have a headquarters at the proposed site, this way they will have an opportunity to get a presence in the capital and still be close to their area of operations. Facilities like technology and research parks will play the major role in the proposed development, other uses that will be there will include office complexes for international firms and support offices for companies located in the city center of Delhi. Efficient road and rail linkages will make this a favorable place for new startups as well for companies who do not need to be in the central business district. These companies can be service oriented like call centers. Land will also be set aside for public amenities like hospitals, schools and there will also be some decentralized government uses. Following are ideas which will make the development a success:

- **Linkage and Connectivity**

  Since the proposed development is at the fringe area of the city, accessibility to the center city as well as other similar developments on the outskirts of the city is important. Accessibility can be achieved by both an extensive road network and also public transit in the form of the metro rail. Since the proposed site has major roadways on both sides it is well connected for automobile transport. In the immediate future dedicated bus ways can be proposed on these roads so as to provide express service to the center city. Inside the development roads are laid in a grid of 300 meter intervals so as to connect to the developments around the site. The criteria for such a layout would be to provide access to the center for residents who are in a radius of approximately 5km. The metro rail will provide the other mode of accessibility to the site. The metro station will be integrated with the commercial development on the site. An intermodal center will be proposed so as to link the development with surrounding areas. A system of local feeder busses and mini vans would be implemented for residents in surrounding areas to get access to the transit line and this would help in supporting the area as well as the transit line. Park and ride facilities would be provided as they reduce the use of the automobile. Pedestrians will also be able to reach the transit station by a system of elevated

walkways from the commercial area in the proposed development. A shuttle service is proposed inside the development linking high density areas to the transit station.

- **Healthier Environment**

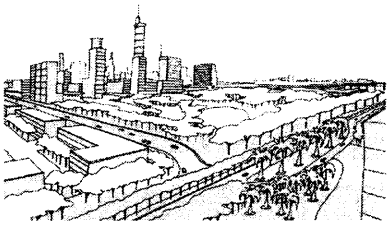
  As stated initially, the development proposes to create a high quality living environment, which will be a pleasant place to live and work. By making it a healthier eco friendly environment the government hopes to encourage people to move from the city center to such developments at the fringe. These developments would support good quality infrastructure, green areas and amenities. There will be large green open spaces for ecological purposes as well as recreational.

- **Major Use to Sustain and Lend an Image to the Development**

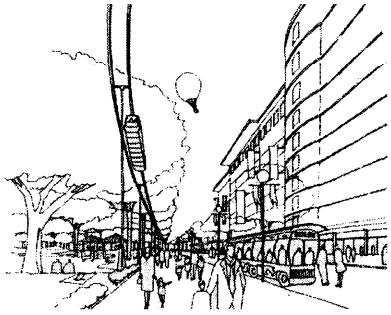
  Apart from the mixed use development on the site, at least one major function is desired to sustain the development financially and also to lend it an image which people can relate to. The major function proposed for the Bawana site is a technology and research park. It will occupy majority of the land in the primary area. In the past few years Delhi has increased its contribution to software production and accompanied with a growth in demand for non polluting manufacturing units, a research and technology park with appropriate infrastructure will be a much needed addition to the city. It would also provide a large employment base and can be located at the outer fringe of the city. This research and technology park can be either built by the city or preferably developed by private builders. It will help establish a unique identity for the center from the already existing functions in the city of Delhi. Also limiting the public development agencies role to assembling the sites, coordinating the development and providing suitable infrastructure, would encourage private sector involvement in building and financing the project, thus resulting in faster completion of the center.

- **Private Mixed Use Development**

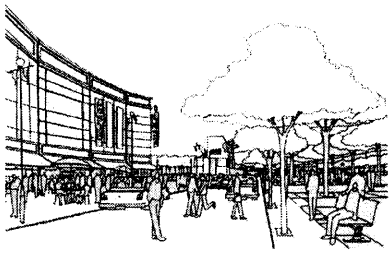
  The goal of the center is to encourage private investment and activity in real estate development on the site. As far as possible mixed use development will be promoted and



[Fig. 5.70] Major uses on site - give an image to the project
Source: BMA

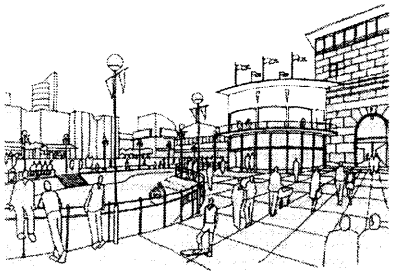


[Fig. 5.71] Transit for movement within the project
Source: BMA

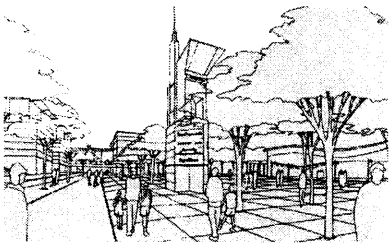


[Fig. 5.72] Private mixed use development
Source:BMA

[Fig. 5.73] An active public realm
Source: BMA



[Fig. 5.74] Attractive public spaces
Source: BMA



[Fig. 5.75] View of the technology park
Source: BMA

functions that will be attracted to the site include: research and technology parks, corporate headquarters, large back office operations of corporations with headquarters in the central business district of Delhi, major retailers, local shops, hotels, hospitality and recreation uses, restaurants, moderate and high density housing, and a full range of institutions such as schools, higher education facilities, religious facilities, social service facilities, district government offices, movie complexes and cultural facilities. The emphasis will be on vertical and horizontal mixing of uses on the same site with commercial uses on ground floors and offices or housing above, hotel and office complexes, integration of cultural facilities with commercial and office areas and so on. The physical layout of the center will help promote this type of development.

- **Public Space Design**

  Since the site will be planned by the public development agency, right of ways can be reserved in advance and infrastructure can also be laid out in advance of development. Thus an organized public realm of streets and squares can be generated with coordinated infrastructure.

■ **Elements of the Primary Area**

The primary area of the Bawana center is to be 150 Ha, but the actual extent of the center will be about 1500 Ha. This will include already existing sites around the primary area. In the primary area an intermodal center is proposed towards the western edge, this will serve as an interchange between cars, busses, metro rail and other forms of transportation like auto rickshaws. Towards the eastern side of the primary area a park is proposed which will support recreational functions. The park is surrounded by research and technology parks and also high density residential development. Commercial uses are located near the intermodal center and around a major road proposed recently by the Delhi Development Authority. This road has been designed as a grand boulevard of 50 m width. This would allow for lanes for express travel and local traffic, as well as generous sidewalks with planting. Commercial frontage along the boulevard is in the form of 300 meter blocks but these can be further subdivided as per the private developer's choice. The boulevard has been imagined as an area

where people will spend time and enjoy themselves. There are sufficient parking facilities on the intermodal center site. Across the intermodal center is an area for government offices, this will be part of a strategy to decentralize parts of the government. Community facilities like schools and hospitals are provided towards the northwest corner of the primary area.

■ Development Plan for the Primary Area

The primary area of the development is planned at two levels. Level one is composed of a series of development units. Each development unit is further divided into a series of block units, which forms the second level of planning in the primary area. Infrastructure will be planned and provided at the level of individual development units. Described below are the general characteristics of both the development and block unit.

- **Development Unit (DU)**
  - Public agency will acquire land and consolidate plots at this level.
  - Infrastructure will be planned by the public agency at this level.
  - General size of the development unit ranges between 20-30 Ha. Average dimension is 270 m by 750 m.
  - Major roads border these units and carry basic infrastructure along them.
  - The government will pay the initial costs for providing large scale lines of infrastructure to each of the development units. Once the units start developing at a finer scale, then private builders will pay for infrastructure and connect their individual plots to the municipal system.

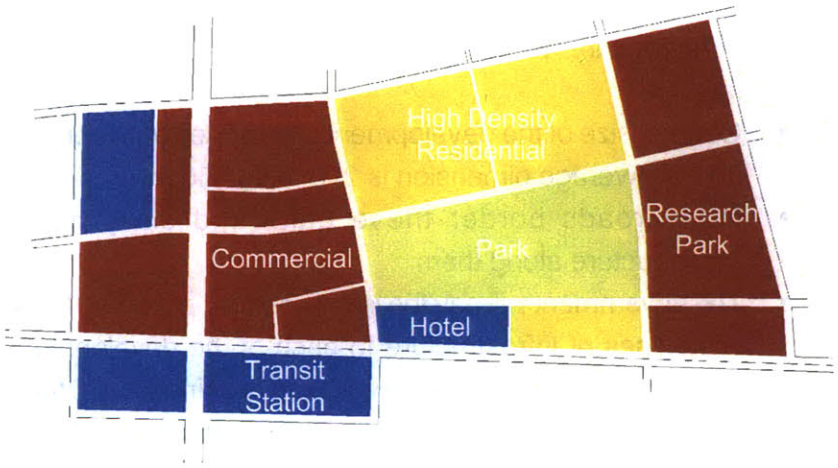
- **Block Unit**
  - Two to four block units form a development unit.
  - Average size of the block is 90 m by 270 m.
  - At this level, infrastructure provision will be the responsibility of the developer or land owner.
  - Block units may be further divided into parcels. The degree of subdivision will depend upon the land use assigned to the development unit. Urban design guidelines will encourage developers to consolidate several parcels to

produce taller or larger buildings and in the process create attractive public and private spaces. The provision of infrastructure by hooking up to the municipal system will be the responsibility of the developer.

■ Land Use and Development Character

The primary area of the center will have high density development comprising primarily of research and technology parks, commercial and residential uses.
Total number of people employed in the primary area: 51,000
Total number of residential units in primary area: 37,000 (residential population: 185,000)

The figure below shows the proposed pattern of predominant land uses in the planned development area. The public and private development split is shown in table 5.16.



[Fig. 5.76] Proposed development plan
Source: Author

As can be seen in the following table, approximately 55% of the total area is given to private development and the balance is divided between public development (3%) and infrastructure and amenities (42%). Out of the 42% dedicated to infrastructure and amenities, approximately 20% is for public circulation like roadways. All sites in the core area should be developed to their maximum potential. This strategy may not be beneficial to all owners (especially those with large parcels in not prime location) but helps to increase overall density, plan for adequate infrastructure and provide efficient transportation systems.

Land Use	Area (Ha)	% of Total Area	Land Use Area (Ha) / 1000 Population
Private Development	**82.5**	**55**	**0.44**
Commercial Uses	27	18	0.14
Hotels	3	2	0.01
High Density Residential	25.5	17	0.13
Research Park	24	16	0.12
Entertainment	3	2	0.01
Public Development	**4.5**	**3**	**0.02**
Government Offices	4.5	3	0.02
Infrastructure and Amenities	**63**	**42**	**0.34**
Roadways	30	20	0.16
Park	19.5	13	0.10
School and Hospital	6	4	0.03
Intermodal Center and Parking	7.5	5	0.04
Total Primary Area	**150**	**100**	**0.81**

[Table 5.16] Land Use Distribution
Source: Author

Land Use	Location on Site	Character
Commercial	Located along the boulevard proposed by the DDA	The FAR proposed for the commercial areas is 6.0 near the intermodal center. The size of these units is to be based on the following guidelines: Development Unit: 300m by 400m Blocks: 100m by 300m It is thought that regional offices for companies will be located here and not international head quarters as they would be in the central business district of Delhi.
Hotel	It overlooks the park and is adjacent to the	The initial use of the hotel will not be very intense but could change in the future depending upon the tourist activity in the area. The FAR proposed for the hotel is 6.0

	entertainment district.	
High Density Residential	It is located on both sides of the park.	Residential blocks will be smaller than usual as high density development will be encouraged. The residential blocks will be 90 by 270 meters and will have ground level parking as well as parking structures. Ideally people working in the research parks will live here and form a sustainable development. The FAR proposed for the residential sites is 4.0 as they face the public park.
Research Park	Located towards the west edge of the development.	The main function of these units will be the development and testing of industrial and manufacturing products. New research oriented universities can open in the surrounding areas of the primary core to build partnerships with companies located in the research park. Students and researchers both will be attracted to the core as a result of such a development.
Entertainment	It is located close to the intermodal center and the hotel.	The area will have small scale restaurants, bars and other recreational activities. It will be connected to the intermodal and commercial centers by a series of elevated walkways.
Government	Located next to the intermodal center on the main boulevard.	The presence of government offices will lend a higher level of stability and importance to the development. Relocating government facilities will be part of its strategy of decentralization and achieving better job - housing balance.
School and Hospital	Public amenities are located in the south east corner of the development.	Delhi currently lacks residential colonies in which quality public amenities are provided. Good public amenities in this development will encourage people to move to such high density centers in the suburbs.

[Table 5.17] Land Use and development character
Source: Author

5.7 COMMON CHARACTERISTICS OF THE MICRO SCALE URBAN INTERVENTIONS

In the previous sections of this chapter it has been demonstrated that the advent of the metro rail can be effectively combined with physical planning measures to transform the urban fabric (variety of land uses) and increase the holding capacity of four different prototypical areas in the city. Although each of the areas would transform differently (depending upon the existing urban fabric

and nature of proposed development), one can expect the following common characteristics (with respect to population, employment density and land use split) to be seen in the city at the various sites suitable for the micro scale interventions.

■ Population Density

City Level

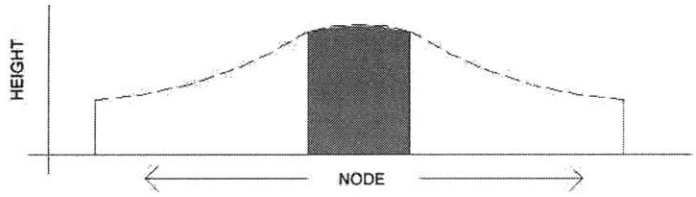
Gross Density: 300-400 pph

Residential Density: 750-800 pph

Nodal Density

Gross Density: 600-750 pph

Residential Density: 750-900 pph

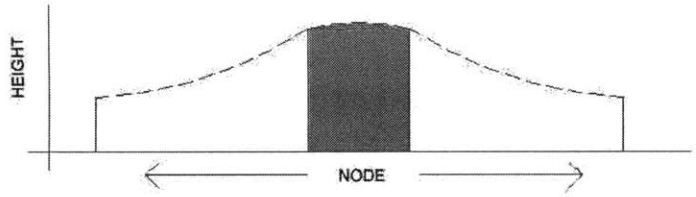


[Fig. 5.77] Population density at node
Source: Author

■ Employment Density

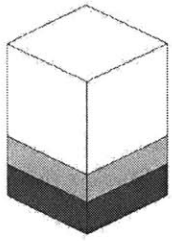
Gross Density less than 400 pph

Development of industries related to IT, non-polluting industries. Low income areas will promote home based industries.

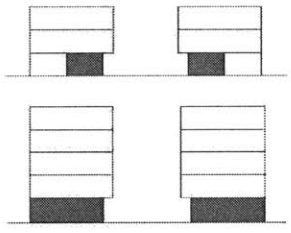


[Fig. 5.78] Employment density at node
Source: Author

■ Mixed Land Use



Vertical land use mix



Horizontal land use mix

[Fig. 5.79] Vertical and horizontal mixing of land uses at nodes
Source: Author

Notes

[1] The area of three square kilometers or three hundred hectares around the station node is based upon a six to eight minute walking time for a person from the transit station to his residence.

[2] National Capital Region Plan of 1997

[3] DDA Project Report on Rohini Development

[4] Ibid

[5] Ibid

[6] Ibid

[7] Ibid

[8] The area of three square kilometers or three hundred hectares around the station node is based upon a six to eight minute walking time for a person from the transit station to his residence.

[9] Primary survey conducted by the author and DDA Project Report on Rohini Development

[10] Ibid

[11] DDA Master Plan, 1981

[12] Primary survey conducted by the author

[13] Delhi Metro Rail Corporation, Phase 1 Report

[14] Primary survey conducted by the author and DDA Project Report on Rohini Development

[15] Gupta, A Study of Resettlement Colonies in Delhi, An unpublished thesis, New Delhi: School of Planning and Architecture. 1992

[16] Ibid

[17] Ibid

[18] Ibid

[19] Ibid

[20] Ibid

[21] Primary survey conducted by the author

[22] Ibid

[23] Ibid

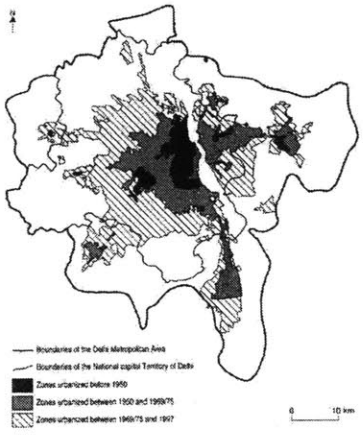
06

DELHI: MACRO SCALE AND EMERGING URBAN FORM

The city of Delhi has experienced rapid urban growth in the last decade as compared to the past thirty years. This growth of the urban boundary has been accompanied with land use changes that are happening at an equally rapid rate. Large investments in infrastructure particularly highways and roads, relocation of industrial units and emerging office and residential developments at the urban fringe have all influenced this changing land use pattern. The city is currently intensifying away from the CBD, highways, roadways and district centers into locations with poorer infrastructure.

The above mentioned phenomenon is the cause of the current pattern of urban sprawl that Delhi is experiencing. If the current trend in land uses accompanied with rapid rate of urbanization continues then in the next twenty years large amounts of rural or agricultural land will need to be urbanized to accommodate the increase in population. The previous Master Plans had made attempts to prevent urban sprawl but a review of the present condition of the city encourages one to question the relevance of the Master Plan approach and its policies for providing Delhi with a sustainable future.

The second Master Plan for Delhi estimated a population of 12.8 million people in 2001 living in a low-rise high-density city. The Master Plan had intended to minimize the average trip lengths and introduce a five-tier system of commercial activities to accommodate required shopping, commercial offices and recreational needs. It had included the provision of district centers to serve as a focal point for multi-nodal activities. By contrast, the 2001 Census indicates that the population of the city of New Delhi alone is 14 million (with an estimated agglomeration of 17 million in the surrounding metropolitan area).



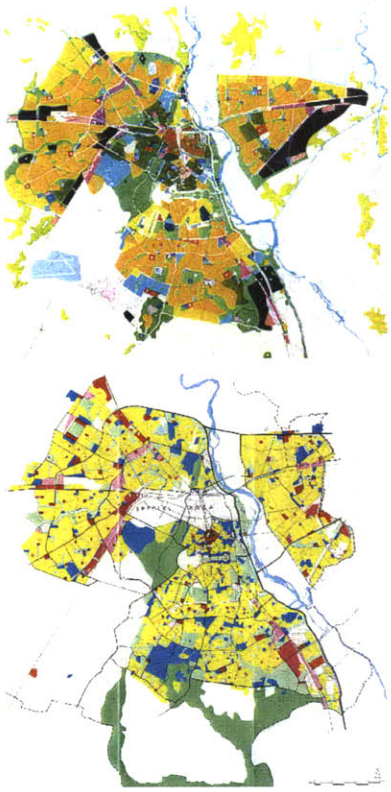
[Fig. 6.1] Growth of Delhi from 1950 onwards
Source: NIUA

The five-tier system of commercial activity has not been implemented and the variety of land uses appears to be falling (shows the increasing homogeneity of land uses in most wards) which would result in higher trip lengths. While mixed land use has curbed the numbers and lengths of primary non-work related trips, the number of trips per household for different purposes remain constant regardless of where the person lives. Nearly 28% of the population, with an income below Rs 2000 per month, can

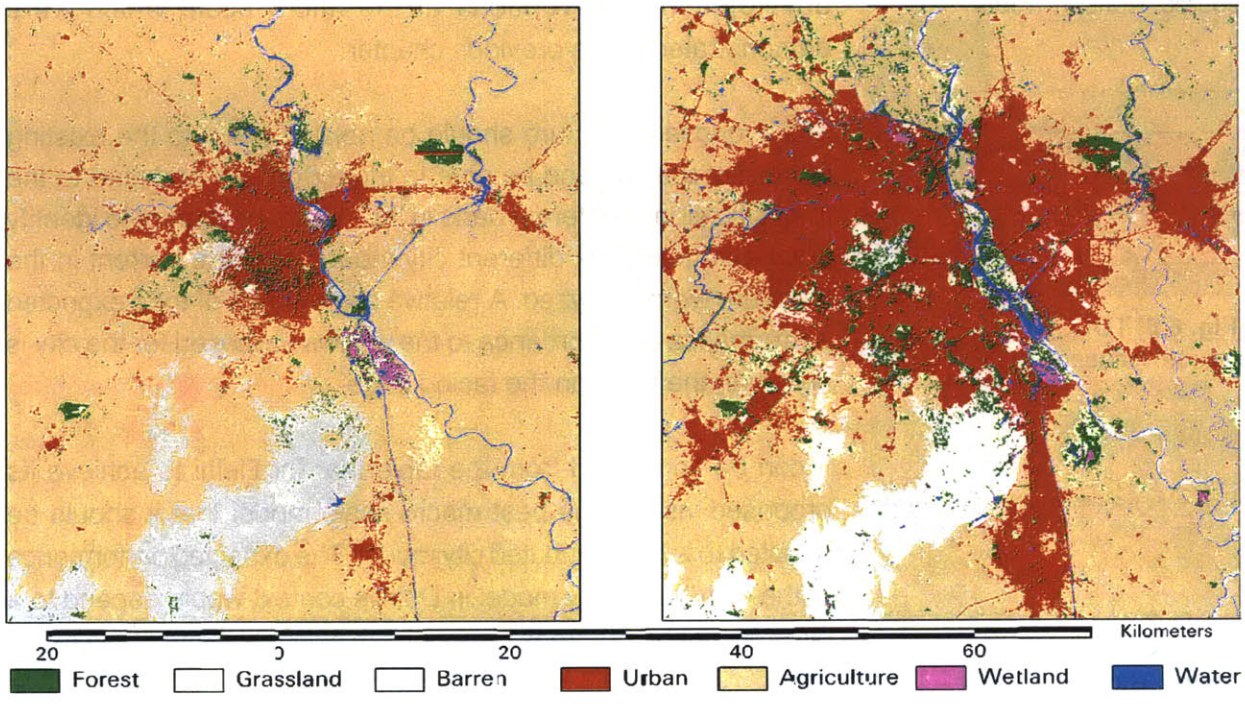
only depend on non-motorized modes. There is no pedestrian or bicycle plan in place to meet the needs of these people. Delhi has the largest number of buses in any city in the world. About 5,000 buses were plying on the roads in 1985, approximately three times the number that were there in 1973, with the current figure estimated to be about 10,000. However, the road system is reaching the maximum level of its ability to accommodate buses and traffic management measures such as high occupancy and bus only lanes may be a necessity to attain reasonable speeds beyond the very low speeds projected for current motorization growth rates.

The Master Planning process in New Delhi is not inclusive of the community, nor is it even guided by data collection. The current plan for 2020, like its predecessor, does not appear to be guided by a concerted effort on the part of the several agencies in Delhi responsible for planning. There have been no visible attempts to collect relevant data, make it available to the public, and advocate the interests of all those living in the metropolitan area.

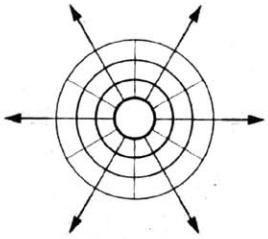
Thus, Delhi faces not only an expansion in terms of its city limits, but also intensification in the use of its land area. The question then is that how can the city be intensified with minimum expansion to the present urban limit. Also is the present practice of preparing



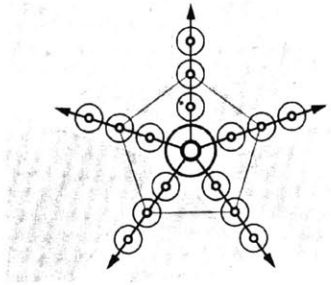
[Fig. 6.2 and 6.3] Top: 1961 Master Plan and Below: 1991 Master Plan
Source: DDA



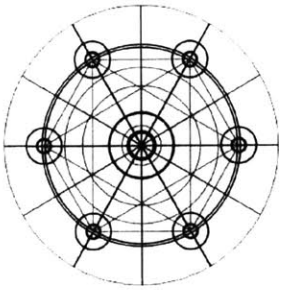
[Fig. 6.4] Spread of Delhi from 1974 to 1999
Source: Harvard University



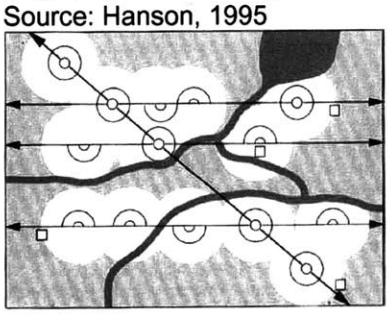
[Fig. 6.5] Core City
Source: Hanson, 1995



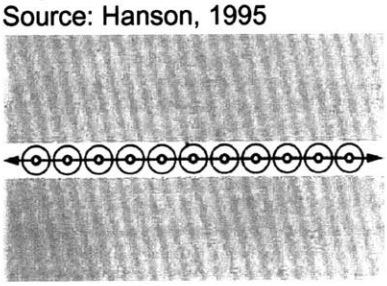
[Fig. 6.6] Star City
Source: Hanson, 1995



[Fig. 6.7] Satellite City
Source: Hanson, 1995



[Fig. 6.8] TOD
Source: Hanson, 1995



[Fig. 6.9] Linear City
Source: Hanson, 1995

Master Plans for 20 years suitable for Delhi's future or should the method and nature of planning be reevaluated.

This chapter attempts to propose a macro model for the city which together with the micro scale interventions in the four prototype areas can help sustain the city in the future with minimum expansion to its present urban limits. This together with a complimentary housing and employment policy can change the form of the city and help increase its absorptive capacity.

6.1 FROM VISION TO AN APPLICABLE MODEL FOR THE CITY

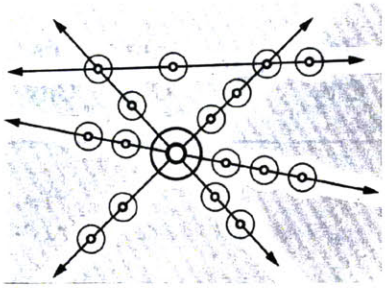
The physical form of the city is of crucial importance to increase its absorptive capacity. For Delhi to accommodate an additional 8-10 million people by 2021, it needs to increase its holding capacity. Strategies for this could include a variety of measures like the urbanization of existing rural land or to develop satellite cities around Delhi.

Past experience shows that the development of satellite cities has not reduced the pressure of population from Delhi rather it has increased the daily trip rate into the city. Hence, a structure for the city is desired that will be able to take advantage of its strong core and existing satellite centers along with the development interventions at the micro scale which were demonstrated in the previous chapter.

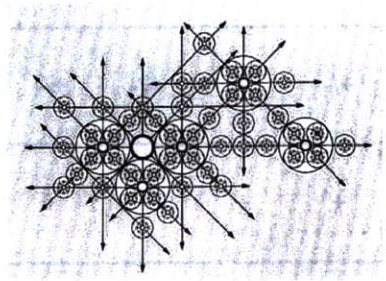
The proposed structure should be able to adapt to the existing pattern of the city and be able to trigger growth and lead to the intensification of different parts in the city. In an attempt to identify such a structure six different city models that are current in the literature were analyzed. A relative comparison of their expected performance in accordance to the visions proposed for the city is shown in the table on the facing page.

It can be concluded from the table that for Delhi to achieve its proposed visions the best macro scale model that it should be adapted to is the distributed city model. The expected performance of the distributed city model in Delhi's context would depend to a large extent on the transformations in existing areas at the micro scale.

Criteria	Core City	Star City	Sat. City	TOD	Lin. City	Dis. City
Degree of containment of development	+	+/-	+/-	-	-	+/-
Population density relative to land required	+	+/-	+	+	+	+
Viability of public transport	+	+/-	+	-	+	+
Dispersal of vehicular transport	-	+/-	+/-	+	-	+/-
Viability of mixed uses	+	+/-	+	-	+/-	+/-
Access to service and facilities	+/-	+/-	+/-	-	+/-	+/-
Access to green open spaces (parks etc.)	-	+	+	+	+	+
Environmental conditions (noise, congestion)	-	+/-	+/-	+	+	+/-
Potential for social mix - variety of housing	-	+/-	+/-	+	+/-	+/-
Potential for local autonomy	-	+/-	+/-	+	+/-	+/-
Potential for self sufficiency	+	+	+	+	+	+
Degree of adaptability of city to changing conditions / needs	-	+/-	+/-	-	+/-	+
Imageabilty of the city as a whole	+/-	+/-	+/-	-	-	+/-
Imageabilty of parts of the city	+/-	+/-	+/-	+	+/-	+/-
Sense of place and centrality	+/-	+/-	+	-	-	+
Weighted (bold)	-4	+1	+2	0	0	+3

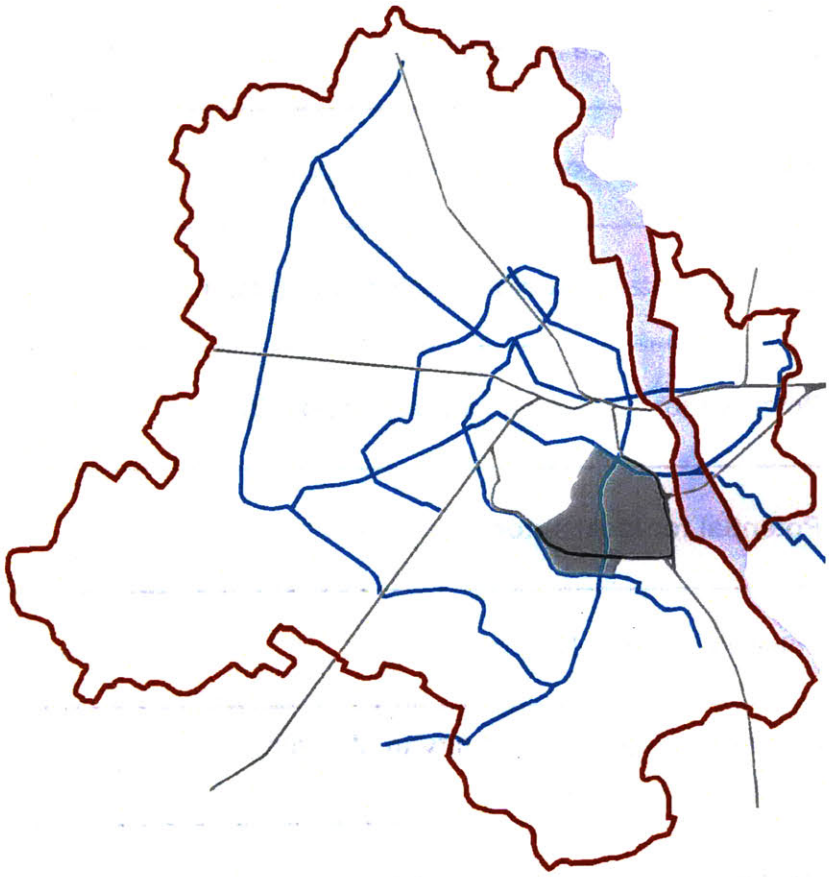


[Fig. 6.10] Distributed City
Source: Hanson, 1995



[Fig. 6.11] Distributed City with transit
Source: Hanson, 1995

The introduction of mass transit lines in the city would superimpose a framework on the existing fabric for a distributed city model development pattern. This coupled with intensification of urban development at nodal points (micro scale development) in the transit corridor will lead to the successful transformation of the city from its present structure to the pattern of the distributed city model. Some of the changes that would be observed in the city as a result of the successful application of the above mentioned model are summarized in the next section.



[Fig. 6.12] New transit corridors in Delhi city
Source: Author

6.2 CHARACTERISTICS OF THE EMERGING URBAN FORM FOR DELHI

The influence of transit at the micro scale coupled with development along the transit corridors will transform the city structure from its present state of sprawl to that of the distributed city model. Some of the characteristics that the city would then display are summarized on the facing page.

■ Degree of Containment of Development

Compactness would be achieved due to high density development at nodal centers and linear development along rail corridors. It would transform the city from its present state of sprawl to a city which is structured along circumferential and radial corridors. As the distributed city incorporates open land within its structure hence nature will be more accessible to people in the city.

■ Population Density Relative to Land Needed

The gross population density will change from the earlier figure of 180 pph (350-400 pph residential) to approximately 250+ pph (600-900 pph residential). The city is also likely to incorporate a number of different development clusters with different sizes and population and to provide a variety of more or less densely grouped areas. There may also be a variety of densities from very high at centers of larger clusters (transit nodes / interchanges) to medium and even low at smaller and more fragmented areas. This would lead to a more equitable distribution of population.

■ Employment Density

Employment centers will be generated closer to homes as mixed land use will be encouraged in the city. This would be in contrast to the existing trend of employment centers being near the 27 district centers in the city. Even if each of the transit nodes is considered as a sub district center then more than 200 such nodes will be present in the city by 2021. This would lead to a more uniform distribution of jobs in the city thus creating a good job housing balance. The employment density is expected to change from the present 150 pph to 350 pph.

■ Viability of Public Transport

Since transit is perceived to be the primary force behind Delhi's transformation, one would see a network of public transport lines with primary and secondary systems meeting at a multiplicity of different centers of different sizes, capacity and specialization. All primary and secondary transport systems in the larger development areas can be expected to be viable. In the smaller and more fragmented areas, only the secondary transport system may be feasible, and less viable owing to the fragmentation of population. Para transit would be encouraged in areas around

transit stations to increase accessibility to the metro rail. At the city level one would see the road trip lengths decreasing and rail trip lengths increasing. This will help in reducing the average travel time and congestion in the city.

- **Trip Pattern**

There would also be a change in trip patterns. The metro rail will enhance a diffused pattern of travel over multiple nodes due to its virtue of increased accessibility. The pattern in general will be evenly distributed over the city as a whole but areas like CBD's and transit stations will see higher intensity of trips. This would lead to a finer grain development in the city. The preferred mode of travel will also change with transit getting the preference over busses, private vehicles and cycles.

- **Dispersal of Vehicular Traffic**

Vehicular traffic would generally be dispersed except when converging on large centers, where congestion is likely to occur. Roads inside high density development areas would therefore be traffic calmed to avoid environmental and functional problems; major vehicular traffic routes would be outside or in between development areas.

- **Viability of Mixed Uses**

Owing to its distributed pattern of development, Delhi would have the potential for the forming of a multiplicity of hierarchically differentiated centers the potential for mixed use would be good but variable. The larger development areas will accommodate more intense and more city wide activities and therefore a large variety of different uses; the smaller development clusters may have provisions for daily or weekly needs only and therefore accommodate a smaller number of different uses.

Hence one may expect the introduction of 'mixed land use' as a category in the next master plan. This would have an effect on land use distribution in the city with an increase in commercial, industrial and recreation areas. The amount of residential land use will either remain the same or would decrease due to the development of high density mixed use centers like the Bawana and Khyber Pass prototype. Land dedicated to transportation

purposes will be significantly reduced as the new transit system will be the primary mode of public travel thus reducing the need for new roads.

- **Access to Services and Facilities**

Access to provision centers should generally be good but can be expected to be uneven; a hierarchy of public transport systems will, however, provide the required mobility for inhabitants to have considerable choice between centers of provision of different size, capacity and specialization.

- **Access to Green Open Spaces**

The fragmentation of the urban fabric and the incorporation of open land will allow good but (with varying distances from centers of larger or smaller development areas) uneven access to green spaces. Some of the open land may be trapped between development, which would reduce its environmental impact and usability; other green spaces may be continuously linked to the country; but overall a symbiotic relationship with nature could be established.

- **Environmental Conditions (noise, pollution, congestion)**

Environmental conditions should be good overall but they are likely to be uneven as a result of larger or smaller development areas, of more or less continuous development in parts of the city. Higher concentration of development may cause some noise, pollution and congestion problems; in smaller and or more isolated development areas environmental conditions will be very good.

- **Potential for Social Mix through Variety of Housing**

There is good potential for social mix as a result of the diversity of development clusters, but it is likely that there will be differences between larger development areas with higher densities at their center and smaller development areas with lower densities.

- **Potential for Local Autonomy**

The potential for local autonomy is good in the smaller development areas and in those larger areas which have a clear hierarchical structure of areas and nodes.

■ **Potential for Self Sufficiency**

The overall potential for self sufficiency will vary for different areas of the city as there will be better and worse access to more continuous and more fragmented open land with various degrees of usability of the land.

■ **Degree of Adaptability**

The proposed structure of the distributed city is open ended and adaptable as it has no rigid geometry and can grow and shrink at the macro scale; changes at micro scale are expected to be by replacement only.

■ **Imageability of the City (the physical entity) as a Whole**

The potential limitless size of the city prevents imageability of the city as an entity.

■ **Imageability of Parts of the City (neighborhoods, districts)**

Nodes and transport channels can be expected to have a strong visual image provided they, and the area they serve, have distinguishable design features and sets of activities.

There will also be a lot of substitution and addition to existing structures in these areas.

■ **Sense of Place and Centrality**

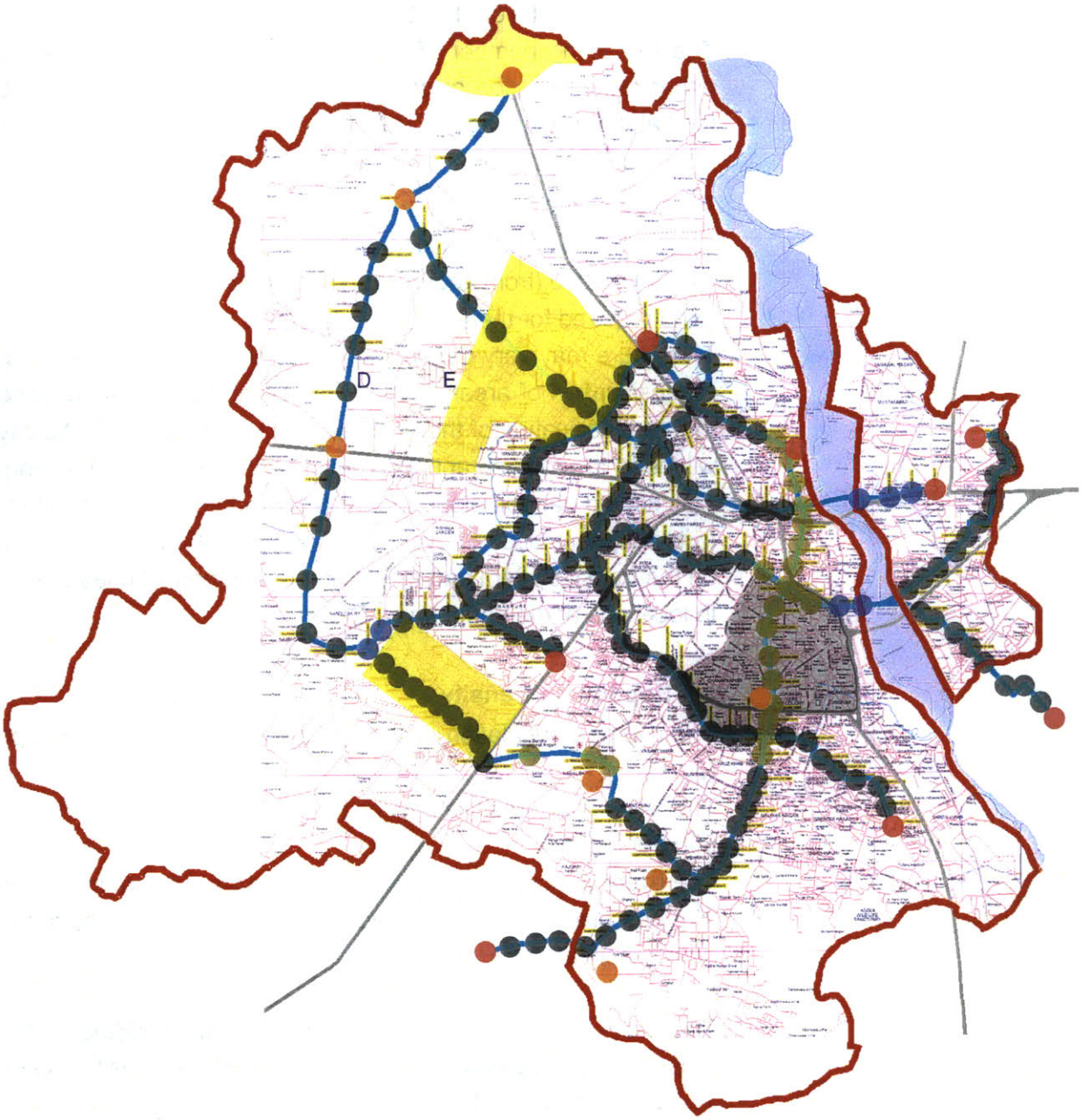
The multiplicity of different nodes at the centers of different urban areas should provide a strong sense of place and a sense of centrality at different hierarchical levels.

6.3 PROPOSED URBAN FORM FOR DELHI - 2021

■ **An Increase in the Absorption Capacity of the City**

Number of people added at each of the prototype nodes:

Rohini: 50,000
Silampur: 90,000
Khyber Pass: 10,000
Bawana: 185,000
Total Number of Stations: 202
At Grade: 9
Elevated: 167; Underground: 26



[Fig. 6.13] Overall plan of Delhi with all transit nodes till 2021
Source: RITES

Additional number of people that can be accommodated in the city:

Rohini Prototype:	5,000,000
Silampur Prototype:	810,000
KhyberPass Prototype:	60,000
Bawana Prototype:	1,110,000
Total:	**6,980,000**
Present Population:	14,370,000
Population 2021:	24,500,000

Additional Population: 10,130,000
The remaining number of people could be accommodated by either redensification of central areas of Delhi or by acquiring land at the urban fringe.

- **Size of the City**

Additional Population that cannot be accommodated in the current city: 3,150,000 (from above absorption capacity calculation)
Land required for them: 10,500 Ha (@300 pph)
This figure may vary depending on the change in regulation for redensification of areas like Lutyens Delhi. But in the scenario that redensification of these areas is not approved then the city will need to urbanize approximately 10,500 Ha of its rural land. This should happen along the transit corridors connecting Delhi to its periphery. Such a development pattern will increase ridership on the transit system and also promote a variety of uses to shift to locations at the periphery.

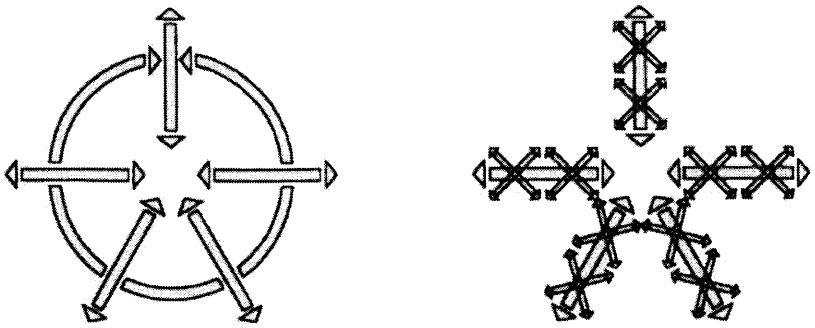
- **Population Density**

The average population density for the city will be 300-350 pph (gross)
The residential density along the transit corridors will be between 600-900 pph
The average population density along the transit corridor will be 400 pph gross (residential land use will be around 40% of the urbanizable area)

Therefore, 70-80% of the population will be residing in the proposed high density corridor along the mass transit system. The population distribution and density gradients will be more uniform from the core to the periphery with significant increase at periphery and middle.

- **Employment Density**

70-75% of the total projected employment for the year 2021 will be located in the proposed high density corridor along the mass transit system. The employment distribution and density gradients will be almost uniform from core to periphery, with significant increase at periphery and middle.



[Fig. 6.14] Change in form of the city, will lead to fine grain development
Source: Author

- **Land Use**

Residential land use will either remain the same or go down by 3-5%
Transport land use will go down by 2-3%
Recreational land use will go up by 2-5%
Industry and commercial land use will increase marginally
Other land uses will increase by 2-3%

6.4 POLICY AND INSTITUTIONAL ADJUSTMENTS

The earlier sections of the thesis made an attempt to demonstrate that how physical design interventions in context with the new mass transit system can accommodate an additional seven million people in the present urbanized area of Delhi. However this can only be realized if it is backed with suitable development policies and an efficient planning process. Master planning in Delhi has largely been unsuccessful in achieving its objectives, some of the key issues responsible for this are: lack of implementation of policies, inefficient governance and planning process.

The presence of too many agencies [Delhi Development Authority (DDA), Ministry of Urban Development (MoUD), Ministry of Railways, Municipal Corporation of Delhi (MCD), New Delhi Municipal Corporation (NDMC), Department of Land Development (DoLD), Government of National Capital Territory of Delhi (GNCTD), etc.] has resulted in lack of coordination, vision and understanding of local problems which has resulted in the failure of governance in the city of Delhi. For any intervention to be successful in the city (whether focused on transit or otherwise) it is crucial that an institutional restructuring of the above mentioned agencies occurs. Following are a few recommendations for the restructuring process:

- MCD and DDA together influence most of the development in the city. Currently they function as independent organizations. It is proposed that they be brought together under GNCTD to get greater administrative control and help in coordinated efforts for development in the city.

- There has to be greater coordination between MoUD and GNCTD. This would be essential as Delhi is governed by both the central government and state government.

- DDA should be re-structured with the development unit working closely with MoUD and the planning unit with GNCTD. This will help in efficient financial budgeting of policies and also the state can coordinate development better.

- Service providing agencies in the city like DVB (electricity), DJB (water) etc. should coordinate with GNCTD; this would ensure that they work with DDA, MCD and the financial section of GNCTD to form comprehensive projects.

To realize the visions for the city it is essential that the above mentioned institutional changes be coordinated with an efficient planning process. The current master planning process has failed to achieve its objectives at both the micro and macro scales and hence a modification in approach is desired.

The modified approach suggests a multi layered planning process which regards physical planning as a continuous process responding to the evolving needs of the community. The approach requires that the concepts of monitoring, and feedback are incorporated into the planning process and physical planning is coordinated with economic planning. A four level planning process is suggested which would require least change to existing planning structure.

The four levels are:

- **Strategic Plan** (for 20 years) for National Capital Territory Region. This would be similar to the present Master Plan but is intended to be more policy oriented influencing regional strategies for growth in the National Capital Territory Region. It would help to look at Delhi in a broader context.

- **Structure Plans** (for 10 years) will be for present municipal areas in the city. These are similar to existing zonal plans but are intended to be more policy oriented.

- **Local Area Plans** (for 5 years) for specific areas in the city. These would help guide the micro scale interventions at transit nodes and other growth centers within the city. These are also intended to be policy oriented and will specify guidelines for infrastructure provision.

- **Priority Area Plans** (for years) will identify areas in the city where projects can be implemented or facilitated by direct government intervention. These could include areas where upgradation is required or where there is potential for public private development.

In a city like Delhi where large land holdings are with the public sector there is an opportunity to use urban land through better management for financing development for the weaker sections of society. There is also an opportunity for the state to revise its role in the development process by limiting itself to infrastructure provision and policy oriented development. It is perceived that the modified planning process will provide the necessary policy and institutional structure for the above to happen efficiently.

6.5 END NOTE

This thesis has made an attempt to demonstrate that through a major investment of transport infrastructure, development patterns can be modified at the micro scale in an efficient and desirable manner to influence the over all urban form and in the process increase the absorptive capacity of the city to accommodate future population growth. It also concurs with the notion that for cities like Delhi that are experiencing urban sprawl, investment in the form of transit is a viable option for them to sustain future growth and development. The thesis is not intended as a final vision for the city but rather proposes ideas and possibilities that should be investigated in more depth as part of future research work.

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